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EXPERIMENTAL APPARATUS

FOR CURRENTS OF HIGH FREQUENCY AND TENSION.

OSCAR F. DAME.

The ordinary induction cell under certain adjustments gives a flaming spark, which we might call high frequency in comparison with the normal output, when we adjust the vibrator at its highest speed and keep the battery amperage unchangeable. Such a spark does not pass in a straight line from one terminal to the other, but assumes a caterpillar shape, carrying with it much more heat than the ordinary discharge, particularly when we close up the gap to one-quarter of its maximum distance.

Should we bridge a small Leyden jar across the secondary terminals, we would note a decided change in the character of the spark, it now being a blue-white instead of a flaming yellow, and decidedly noisy. Such a spark has greatly increased in frequency, and is alternating in character. The experiments are of great interest, in that they permit of the construction of apparatus similar to that built and operated by Tesla in his most original experiments some years ago. His experiments have been very numerous, and to possess

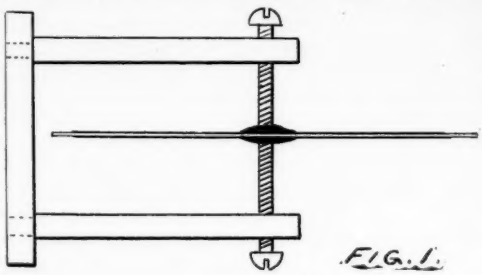


FIG. 1.

all the apparatus necessary for them would involve a considerable outlay, but it is possible for any one possessing an induction coil giving over 1-in. spark, to produce these alternating currents of high-frequency at very small expense, using such materials as may be found in nearly every home workshop.

The first requisites are two glass condensers or capacities. These may be in the form of Leyden jars or glass plate condensers. Leyden jars are easy to make but not always neat in appearance when home-made, as tinfoil cannot be applied evenly to glass cylinders without considerable trouble. The writer found it possible to construct condensers out of large panes of sheet glass, extra thin, of a size about 18 by 24 in. Each side is coated with tinfoil to within 2 in. of the

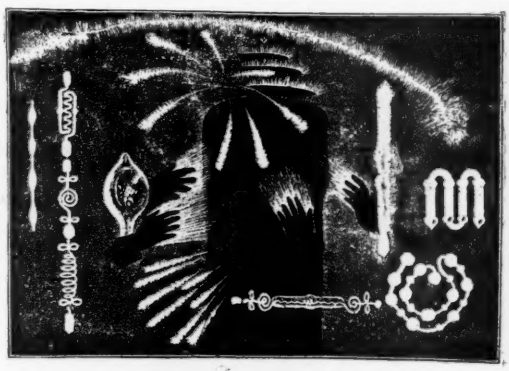


FIG. 2.

edges on both sides. If it is not possible to secure large sheets of tinfoil, smaller pieces overlapping one-another to make perfect contact may be used. The pieces of glass are carefully shellacked on both sides, particularly at the edges, but with the exception of a central spot on each side exactly 2 in. in diameter. The glass is then mounted on a wooden baseboard, between two supports made of dry wood or rubber, and with adjustable plates, which also serve as contact plates and terminals. There is no particular method of designing this support, but a simple way is to em-

ploy two long machine screws for adjusters. These may be tightened with a screw-driver, as required. A side view of one of these condensers is shown in Fig. 1.

In connecting with the induction coil it is necessary to use ¾ in. balls on the spark gap and separate same between ¼ and ⅜ in. Placing the two plate condensers upon the table, two feet apart, the outer terminals are connected by metal chains to the spark gap knobs above referred to. To the inside terminals, thereby completing a circuit through the condensers, will be connected a "resonator" which is probably a new device to many AMATEUR WORK readers, but which will be found available in all high frequency and wireless telegraph experiments. A resonater is a solenoid or spiral of heavy wire of low resistance, the turns of

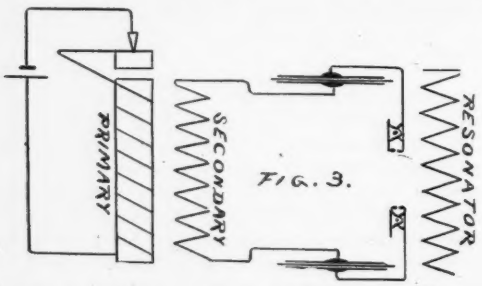
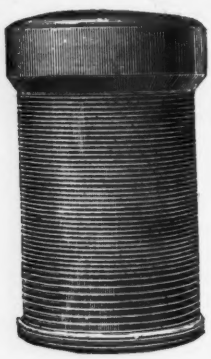


FIG. 3.

which are fully ¼ of an inch apart. The resonator here required should be of No. 12 bare copper wire, wound in 40 turns about a cylinder of dry wood 6 in. in diameter. As the wire is to be wound in open spiral it will be advisable to have the cylinder at least 18 in. high, and a fair estimate of wire length is 70 feet. This wire is tacked to the wood at the two ends, and the entire resonator placed in a pan and basted with boiling paraffine until the wood is well filled with the wax. Any wax that may stick to the outside of the wire readily falls off.



The writer used birch wood in constructing his resonator, because it is very porous, taking up plenty of wax and so permitting a more thorough insulation. This cylinder is mounted on a baseboard for convenience in handling. The two connecting wires are in reality light brass chains with suspender clips fastened to the ends. In this way, any part of the wire may be used for the resonance. In fact, it requires some experiment to ascertain just how much of the spiral is to be included in the condenser circuit to give the proper frequency. This resonator when used with a coil ordinarily giving from one to three inches spark, will deliver a volume of radience of surprising intensity, permitting the performance of the most curious and instructive experiments. In the dark we may observe all around it a very intense electro-static field, and it is possible by simply holding in the hand such objects as incandeseent lamp bulbs and Geissler tubes to render same luminous. The larger the coil in use he better the results. The effects shown in the illustration were from a 4-in. coil, but similar and just as brilliant results of a lesser magnitude were obtained from a 1½ in. coil working on six dry cells. A diagram of all connections is shown in Fig. 3.

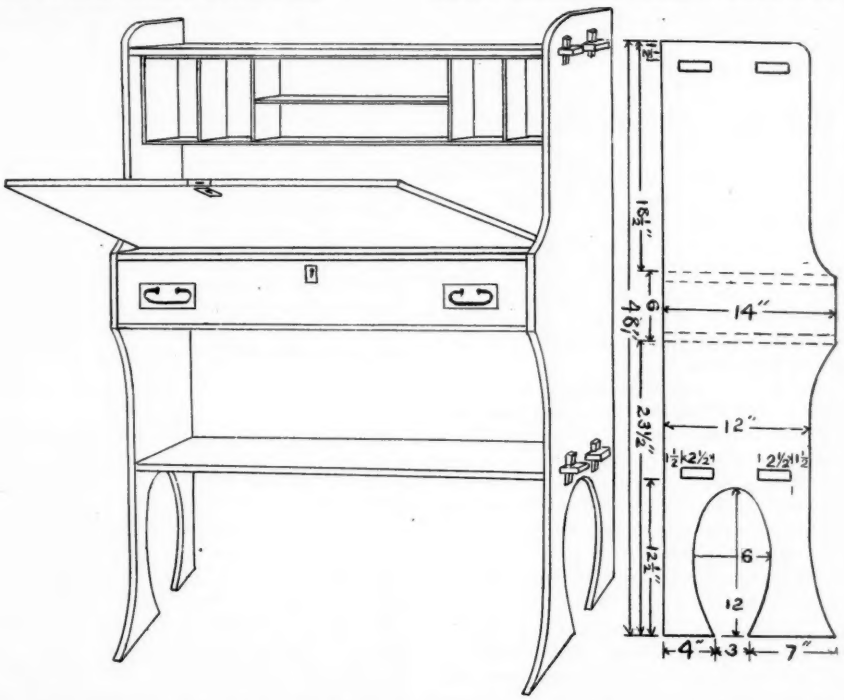
A spontaneously moving stone ball in a cemetery at Marion, Ohio, is attracting a great deal of attention It is 36 in. in diameter and rests upon a heavy pedestal. This ball is slowly turning upon its base, revolving about a horizontal axis in a direction from north to south, presumably by the action of the sun's rays. The monument was erected a number of years ago, but its movement was not known until the spring of 1904, since which time it has been watched and measured repeatedly, and it is established beyond question that the stone is turning continually. The ball was never securely fastened to the base, but an unpolished part of it was set in a socket, and the friction of the two rough surfaces was relied upon to prevent any displacement. At the present time, however, the rough spot is nearly half way to the top on the north side, and has moved more than 5 in. since August 1 last year. There is very little chance for the perpetration of a hoax in connection with this interesting phenomenon, as the ball weighs 4200 pounds and would require extensive machinery to move it. The State geologist suggests that the rotary movement is probably due to two causes. First, the ball becomes more heated than the heavy base and consequently expands more, giving rise to a slight creeping. The ensuing contraction might not be sufficient to take up the displacement caused by the heat in the earlier part of the day. Secondly, the circumference of the sphere may be regarded as lengthening out on one side and giving rise to a pulling stress between the ball and the base upon which it rests.

"If you are a good workman you will not be a good kicker. The two do not fit."

AN OCCASIONAL DESK.

JOHN F. ADAMS.

The desk here described will probably interest pupils in manual training schools who are looking about for some article of furniture which they can make and show to friends as evidence of the skill they have acquired. Let us hope that those who attempt this design will take enough time and care with the work so that their friends will find it an easy matter to give their approbation. As the design is not a difficult one it should be easily within the capacity of any second year pupil of a manual training high school. Oak or mahogany are the most suitable woods to use.



The general dimensions are: 48 in. high, 34 in. wide and 14 in. deep. If the shelves are made without the extensions for the pins, the width is 30 in. The dimensions and shape of the sides are clearly shown in the illustration. The extra width at the center and bottom can be obtained by gluing strips 2 in. wide onto a board 12 in. wide, using care to match the grain at the joints. The outer sides are spaced 30 in. apart.

The top and lower shelf are 34 in. long and 12 in. wide. The ends are cut out to form lugs 2¾ in. long and 2½ in. wide, the outer edges of each lug being 1½ n. from the edges. Holes are cut in these lugs for pins, after fitting to the holes in the sides and marking the exact positions of the holes. The pins are 3 in. long, ¾ in. wide, ⅝ in. thick at top, ⅜ in. thick at the bottom ends. On the under side of the back edge of the top, cut a rabbet ½ in. wide and deep for the backing.

The shelf over the drawer is 29 in. long and 13½ in. wide. Grooves about ¼. in deep are cut in the sides to receive the ends of this shelf, leaving about 1 in. at the front without the groove. The ways for the drawer consist of a frame of strips 2½ in. wide, with halved joints. Grooves are also cut in the sides for this frame, which is the same size as the shelf above.

The drop lid is 28¼ in. long and 16 in. wide and will have to be glued up from two pieces, the grain of which should be nicely matched, as it is the most conspicuous part of the desk. Cleats 2 in. wide and ⅝ in. thick will have to be fitted to the ends on the inner side, to prevent warping.

The pigeon holes at the top are made up separately from the desk and put in place with screws. Maple ¼ in. thick and 10 in. wide is used throughout. The top and bottom pieces are 28 in. long, and the two end

pieces 6¼ in. long, the four division pieces 5¾ in. long, and the shelf at the center 11 in. long. Small wood screws ⅝ in. long should be used throughout for fastening together, except the center shelf, which is put in with wire finish brads ¾ in. long. The two pieces at the ends of this shelf should be put on before they are fastened in.

The back is sheathed with matched sheathing ¼ in. thick which should be well seasoned to prevent opening up cracks.

The drawer is 28½ in. long, 13 in. wide and 4¼ in. deep. The construction of a drawer has been so frequently described in these articles that it will not be repeated here.

The lid is attached to the shelf with brass hinges recessed into both lid and shelf. A lock is also fitted to the top edge, the tongue plate being fitted to the under side of the top shelf. A lock and drop handles are also fitted to the drawer.

BOOKS RECEIVED.

FORGE PRACTICE. John Lord Bacon. 257 pp. 7¼ x 4¾ inches. 272 illustrations. Cloth, $1.50. John Wiley & Sons, New York.

The increased attention now being given to this subject in manual training and technical schools, makes the publication of this book most opportune. It is the outgrowth of a series of notes given the students at Lewis Institute, Chicago, in connection with shop work of the character described.

It requires but a most casual examination to show that the author is well fitted for the task in hand and has presented the several parts of his subject in an exceptionally clear and attractive way. While intended as an elementary work, it is sufficiently complete so that anyone mastering the contents will be as well educated as the better run of forge hands. The amateur desirous of acquainting himself with the subject can find no better book for the purpose, as the exercises are of a most practical kind.

MACHINE CONSTRUCTION AND DRAWING. Frank Castle, M. I. M. E. 275 pp. 9½ x 7 inches. 266 illustrations. Oblong flexible cloth, $1.25. The Macmillan Co., New York.

This is the most complete book upon this subject, and at low cost, which has been brought to our attention. To the student, working alone it is especially suitable, as it contains a large amount of supplementary information regarding the proportions of parts and the methods for obtaining them which would be very useful to the draftsman. An unusually large number and great variety of machine and engine details are illustrated, which though of English design, are of a general character making them suitable for teachers in need of studies for class work, or for advanced students doing special work. Every teacher of mechanical drawing will find it a most useful book, as will also anyone wishing to take up the study without a teacher.

ELECTRIC WIRING, DIAGRAMS AND SWITCHBOARDS. Newton Harrison, E. E. 272 pp., 7½ x 5 inches. 105 illustrations. Cloth, $1.50. The N. W. Henley Pub. Co., New York.

The intention of the author was to present this subject in language suited to the general reader, so far as a technical subject of this kind will allow of such treatment. Simple methods are given for working out wiring circuits; the principles of switchboard design are also suitably presented. The working lineman and the amateur who desires a working knowledge of these subjects will find the book of great assistance toward that end.

ELECTRICIAN'S HANDY BOOK. T. O'Conor Sloane, A. M., E. M., Ph. D. 761 pp. 6¼ x 4¼. 556 illustrations. Flexible leather. $3.50. The N. W. Henley Pub. Co., New York.

The immense field now embraced by the term "Electrical Engineering" makes it necessary that the working electrician have at hand every facility in the way of reference book which it is possible to obtain. This is also true of the teacher, and of the student whose means will permit of the purchase of books of this kind. The mention of the number of pages and illustrations contained in this book indicates its comprehensive character, and as the price is most moderate it will undoubtedly meet with the cordial reception which its merit deserves.

For making fire in the Philippine Islands, there is a curious contrivance used by some few of the natives of Northern Luzon. It consists of a hardwood tube of about 1 centimeter bore and 6 centimeters in length, and a piston of slightly less diameter and length. The tube is closed at one end by an air-tight plug or, instead, the wood forming the tube is not bored through its entire length. The inside of the tube is smooth and highly polished. The piston has a handle, and resembles the piston of a boy's popgun. The end of the piston is made to fit the tube airtight by a wrapping of waxed thread, and directly in the end of it a shallow cavity is cut. Lint scraped from weather-beaten timber and well dried is used for tinder. A small bit of this lint is placed in the cavity at the end of the piston, the latter is inserted ½ in. in the open end of the tube, and then driven quickly home with a smart stroke of the palm. Upon withdrawing the piston the lint is found ignited, the sudden compression of air generating the necessary heat.

"The better workman a man is, the better the world looks to him."

A HAND DRILL PRESS.

HERBERT O. BACON.

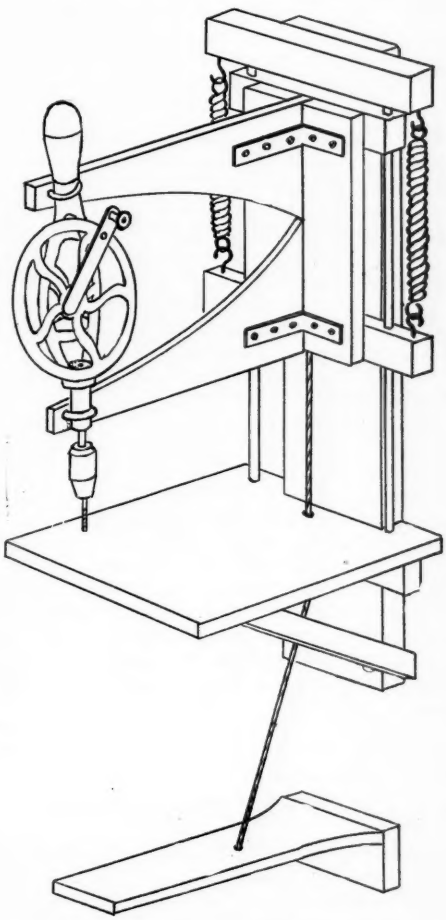
The frequent breaking of small twist drills when used in a hand drill upon metal, led me to make the holder for the hand drill with foot-power feed, which is here described, and the use of which greatly reduced the breaking of drills, and afforded other advantages quite evident to any one familiar with work on a drill press. In this device the drill moves, the table is stationary, which permits of placing the work at any angle in relation to the drill and fastening the same when necessary to guard against any movement.

The exact dimensions of the different parts will depend upon the size and shape of the hand drill, but the different makes vary but little, and therefore the specifications given will be suitable for most kinds. The principal points to be seen to are: That the hand drill is securely fastened to the frame and that the frame is strongly constructed without side play, as it is the latter that causes the drills to break.

The general make-up is shown in the illustration. Obtain a piece of spruce plank 3 ft. long, 6 in. wide and 2 in. thick, which will plane up to 1¾ in. thick. Also four feet of 2 x 3 in. spruce, which will plane to 1¾ x 2¾ in. and from which cut three pieces, 12 in. long and one piece 10 in. long. One of the 12-in. pieces is put across the top of the plank, one forms the lower carrier of the sliding frame, and the third piece supports the table. The 10-in. piece is for the upper carrier of the frame.

To the carriers of the sliding frame nail two strips about 6½ in. long, 3 in. wide and ¾ in. thick, between which are fastened the two arms for holding the hand drill. The arms are cut out to the shape shown, and of dimentions suitable for the hand drill to be used, and are securely fastened with screws to one of the vertical pieces just mentioned, and then to the carriers. The other vertical piece is then put in place, and two angle irons put on to prevent side play. The outer ends of the arms are then recessed to fit the hand drill, which is held in place by two clips. (Sleigh clips can be obtained of any carriage supply dealer or repair shop.) These clips have flat iron centers with threaded ends. They are bent to an U-shape to fit around the hand drill, holes being bored in the arms to receive the threaded ends, and the nuts are then tightened up, holding the hand drill firmly in place.

The hand drill frame slides upon two rods, which may be of brass tubing or drawn steel shafting ¾ in. diameter and 18 in. long, or 1-in. hickory dowel rods may be used. Holes are bored part way into the upper cross piece and the piece under the shelf, and clear through the two cross pieces on the drill frame. Care must be taken that these holes are accurately spaced and in line, especially in the sliding frame, to avoid friction or bends in the rods, which would prevent the frame from sliding easily. After boring the holes, those in the frame should be smoothed up with a round file, to give an easy fit to the rods. When properly fitted the table, a piece of



oak 15 x 12 x ⅞ in., is attached with screws to the support, the holes for the rods put through this board, and the parts assembled; the table is then secured in place. Braces are fastened on either side of the back plank and to the front of the table.

Two screen-door springs are then attached to the under piece of the frame and top cross piece, as shown in the illustration, using heavy screw-eyes for fasten-

ing. The springs should have tension enough to hold the frame at the top of the rods, and yet allow it to be brought down easily when the pressure of the foot is applied to the lever underneath.

The treadle needs no description, being simply two boards, jointed with a strong T hinge on the under side. A piece of sash cord is attached to the center of the lower cross piece of the frame; carried through a hole in the table, on the under side of which is an ordinary window pulley, to the treadle, in which a hole is bored, the cord being knotted underneath. Graphite is a good lubricant for the rods, as it prevents wear of the cross pieces.

A BLOW SYRINGE.

A discarded bicycle pump was utilized to make a blow syringe which has been extremely useful about the house, especially in removing dust from the piano, and a description is given with the hope that it will be found of value by other readers of AMATEUR WORK. The shape makes it much more convenient than the bellows commonly used, and the cost, even if a new pump has to be purchased, is much less then for a bellows. In printing offices it would be serviceable for cleaning the dust from the case.

The casting at the lower end of the pump is entirely removed, which is easily done by unscrewing it from the tube. The top of a cheap zinc oil can is then cut off at the proper place to make a good fit for the end of the pump and soldered to the narrow collar that will be found thereon. In cutting off the top of the oil can, leave about ¼ in. extra metal to form into a shoulder to fit inside the collar, making the work of soldering an easy matter. Ordinary soft solder may be used with rosin as a flux. The oil nozzle should be removed while soldering to the tube to avoid bending it. It may also be found necessary to file off a small part of the outer end of the nozzle, if a small one is used, to allow a larger volume of air to pass when using the pump.

FAITH AND PERSISTANCE.

In that very human little story "Mrs. Wiggs of the Cabbage Patch," appears this sentence: "Leaders of great enterprises must, of necessity, turn deaf ears to words of discouragement." Which is to say that every great enterprise depends upon the hope, belief, enthusiasm and persistence of some one man.

The world owes its victories to the men who have turned a deaf ear to the pessimists, obstacle hunters, and trouble scientists.

The way to succeed is to prepare for success, and this centering of your thought and time and energy in one direction is the mental macadam that the road of life needs to make the going easier.

Hope awakens the ambition, expectancy stimulates and sharpens the senses, and belief fires the will. Business, like religion, is founded on belief. Every new cult starts in the conviction of some one man. He tells others, and they believe it because he does, and the first thing you know we have a white marble edifice and a million converts.

So that when a man starts out with a proposition that he believes in—whether it is religion, rails or raisins—if he'll just close his ears to the "discouragers," and look for "encouragers," it won't be long before he'll have enough followers to rear his temple or steel plant or raisin factory, as the case may be, with buyers waiting at the front door clamoring for back orders.

Paper making from furze may, if successful, open up a large class of new paper-making materials and possibly prove the solution to the serious problem caused by the rapid exhaustion of the timber districts in the effort to meet the demand for wood pulp, the now universally used material. It has been ascertained that the furze, suitably treated, produces a very white and solid pulp by the following treatment: 1000 kilogrammes of the green plant, cut up as fine as possible, are mixed with caustic soda lye of 30° B. and raised to a temperature of 170° in an autoclave, under pressure. After a boiling of five or six hours, the pulp is washed with water, accidulated with sulphuric acid in suitable quantity, bleached with chloride of lime and washed thoroughly, when it is in a suitable state for employment in the manufacture of paper.

The flowing of solid concrete is an accomplished fact. Compression tests recently carried out by Prof. H. Woolson, of Columbia University, on cylindrical test pieces of concrete seventeen days old and 12 in. by 4 in. diameter, showed that the material flowed under a load of 120,000 lb. to 150,000 lb. The concrete was contained in steel tubes. Two test pieces were compressed by more than 3 in., and the diameter correspondingly increased. It was supposed that this excessive distortion had completely disintegrated the concrete and left in a powdered mass, but when the steel tube was sawn apart and removed, the concrete was found to have taken the exact shape of the distorted tube and was solid and perfect.

Phosphor bronze is an alloy of phosphor, tin and copper, containing usually 5.053 to 0.76 per cent phosphorus and four to ten per cent tin, balance copper. It is as tough as wrought iron, more ductile than copper and is capable of withstanding great wear.

CEMENT MORTAR AND CONCRETE.

PHILIP L. WORMELEY, JR.

II. Methods of Mixing Mortar.

Cement concrete is the product resulting from an intimate mixture of cement mortar with an aggregate of crushed stone, gravel or similar material. The aggregate is crushed or screened to the proper size as determined from the character of the work. In foundation work, stone or gravel 3 inches in size may be used to advantage, whereas in the case of molded articles of small sectional area, such as fence posts, hollow building blocks, etc., it is best to use only such material as will pass a one-half inch screen. An ideal concrete, from the standpoint of strength and economy, would be that in which all voids in the aggregate were completely filled with sand, and all voids in the sand completely filled with cement, without any excess. Under these conditions there would be a thoroughly compact mass and no waste of materials.

It is a simple matter to determine the voids in sand and also in the aggregate, but in mixing concrete the proportions vary a great deal, depending in each case upon the nature ot the work and the strength desired. For example, in the construction of beams and floor panels, where maximum strength with minimum weight is desired, a rich concrete is used, whereas in massive foundation work, in which bulk or weight is the controlling factor, economy would point to a lean mixture.

When good stone or gravel is used, the strength of the concrete depends upon the strength of the mortar employed in the mixing and upon the proportion of mortar to aggregate. For a given mortar the concrete will be strongest when only enough mortar is used to fill the voids in the aggregate, less strength being obtained by using either a greater or less proportion. In practice it is usual to add a slight excess of mortar over that required to fill the voids in the aggregate.

It is more accurate to measure cement by weight, unless the unit employed be the barrel or sack, because when taken from the original package and measured bulk there is a chance of error due to the amount of shaking the cement receives. As it is less convenient, however, to weigh the cement it is more common to measure it by volume, but for the reason stated this should be done with care.

For an accurate determination of the best and most economical proportions where maximum strength is required, it is well to proceed in the following way: First, proportion the cement and sand so that the cement paste will be 10 per cent in excess of the voids in sand; next determine the voids in the aggregate and allow sufficient mortar to fill all voids, with an excess of 10 per cent.

To determine roughly the voids in crushed stone or gravel, prepare a water-tight box of convenient size and fill with the material to be tested; shake well and smooth off even with the top. Into this pour water until it rises flush with the surface. This volume of water added, divided by the volume of the box, measured in the same units, represents the proportion of voids. The proportion of voids in sand may be more accurately determined by subtracting the weight of a cubic foot of quartz and dividing the difference by 165.

For general use the following mixtures are recommended:

1 cement, 2 sand, 4 aggregate for very strong and impervious work.

1 cement, 2½ sand, 5 aggregate, for work requiring moderate strength.

1 cement, 3 sand, 6 aggregate, for work where strength is of minor importance.

In the case of gravel containing sand or crushed stone from which the small particles have not been removed by screening, the amount of such sand or fine stone should be determined and due allowance made for it in proportioning the mortar.

When mixing an aggregate containing small particles with mortar, the same conditions obtain as if these particles had been screened from the aggregate and added to the sand used in making the mortar, and in reality we have a mortar containing a larger proportion of sand than was present before the aggregate was incorporated. It is evident, then, that in such cases the quality or richness of the mortar should depend upon the proportion of fine material in the aggregate.

For example, suppose that 1 cubic foot of gravel contains 0.1 cubic foot of sand, and that the voids in gravel with sand screened out measure 40 per cent.

For general purposes this would suggest a 1-2-5 mixture, but since each cubic foot contains 0.1 cubic foot of sand, 5 cubic feet of gravel will contain 0.5 cubic foot sand, and the proportions should be changed to 1 part cement, 1½ parts sand, 5 parts gravel.

It has been demonstrated that concrete can be mixed by machinery as well, if not better, than by hand. Moreover, if large quantities of concrete are required, a mechanical mixer introduces marked economy in the cost of construction. None of the various forms of mechanical mixers will be described here, since concrete in small quantities is more economically mixed by hand.

MIXING BY HAND.

In mixing concrete by hand a platform is constructed

as near the work as is practicable, the sand and aggregate being dumped in piles at the side. If the work is to be continuous, this platform should be of sufficient size to accommodate two batches, so that one batch can be mixed as the other is being deposited. The cement must be kept under cover and well protected from moisture. A convenient way of measuring the materials is by means of bottomless boxes or frames made to hold the exact quantities needed for a batch.

A very common and satisfactory method of mixing concrete is as follows: First measure the sand and cement required for a batch and mix these into mortar, as previously described. Spread out this mortar in a thin layer and on the top of it spread the aggregate, which has been previously measured and well wetted. The mixing is done by turning with shovels three or more times, as may be found necessary to produce a thoroughly uniform mixture, water being added if necessary to give the proper consistency. The mixers, two or four in number, according to the size of the batch, face other and shovel to right and left, forming two piles, after which the material is turned back into a pile at the center. By giving the shovel a slight twist, the material is scattered in leaving it and the mixing is much increased.

A dry mixture, from which water can be brought to the surface only by vigorous tamping, is probably the strongest, but for for the sake of economy and to insure a dense concrete well filling the molds, a moderately soft mixture is recommended for ordinary purposes. Where the pieces to be molded are thin, and where small reinforcing metal rods are placed close together or near the surface, a rather wet mixture may be necessary to insure the molds being well filled.

In the manufacture of such articles as pipe, fence posts, and hollow blocks, a rather large proportion of quick-setting cement is used, the object being to reduce the weight and consequent freight charges by means of a strong mixture, as well as to make the concrete impervious to water. The use of a quick-setting cement permits the molds to be removed sooner than would be possible with a slow-setting cement, thus reducing the number of molds necessary for a given output. Quick-setting cements are not recommended for such purposes, however, as they are usually inferior to those which set slowly.

In coloring cement work the best results are obtained by the use of mineral pigments. The coloring matter, in proportions depending upon the desired shade, should be thoroughly mixed with the dry cement before making the mortar. By preparing small specimens of the mortar and noting the color after drying, the proper proportions may be determined.

For gray or black, use lampblack.

For yellow or buff, use yellow ocher.

For brown, use umber.

For red, use venetian red.

For blue, use ultramarine.

DEPOSITING CONCRETE.

Concrete should be deposited in layers of from 4 to 8 inches and thoroughly tamped before it begins to harden. The tamping required will depend upon the consistency of the mixture. If mixed very dry it must be vigorously rammed to produce a dense mass, but as the proportion of water increases less tamping will be found necessary. Concrete should not be dumped in place from a height of more than 4 feet, unless it is again mixed at the bottom. A wooden incline may be used for greater heights. Rammers for ordinary concrete work should weigh from 20 to 30 pounds and have a face not exceeding 6 inches square. A smaller face than this is often desirable, but a larger one will be less effective in consolidating the mass.

In cramped situations special forms must be employed to suit the particular conditions. When a thickness of more than one layer is required, as in foundation work, two or more layers may be worked at the same time, each layer slightly in advance of the one next above it and all being allowed to set together. At the end of a day there is usually left a layer partially completed which must be finished the next day. This layer should not be beveled off, but the last batch of concrete should be tamped behind a vertical board forming a step.

To avoid introducing a plane of weakness where fresh concrete is deposited upon that which has already set, certain precautions have to be observed. The surface of the old work should be clean and wet before fresh material is put on, a thin coating of neat cement grout being sometimes employed to insure a good bond. The surface of concrete to receive an additional layer must not be finished off smoothly, but should offer a rough surface to bond with the next layer. This may be done by roughing the surface while soft with pick or shovel, or the concrete may be so rammed as to present a rough and uneven surface. Wooden blocks or scantling are sometimes embedded several inches in the work and removed before the concrete hardens, thus forming holes or grooves to be filled by the next layer.

As stated before, it is important that concrete be tamped in place before it begins to harden, and for this reason it is proper to mix only so much at a time as is required for immediate use. The retempering of concrete which has begun to set is a point over which there is much controversy. From tests made in the laboratory it would appear that such concrete suffers but little loss of strength if thoroughly mixed with sufficient water to restore normal consistency.

The time required for concrete to set depends upon the character of the cement, upon the amount and temperature of the water used in mixing, and upon the temperature of the air. Concrete mixed dry sets more quickly than if mixed wet, and the time required for setting decreases as the temperature of the water rises. Warm air also hastens the setting.

Portland cement concrete is well adapted for work

exposed to sea water, but when used for this purpose it should be mixed with fresh water. The concrete must be practically impervious, at least on the surface, and to accomplish this the materials should be carefully proportioned and thoroughly mixed. It is also of great importance that the concrete be well compacted by tamping, particularly on exposed surfaces.

Although it is advisable under ordinary circumstances to discontinue cement work in freezing weather, Portland cement may be used without serious difficulty by taking a few simple precautions. As little water as possible should be used in mixing, to hasten the setting of the cement. To prevent freezing, hot water is frequently used in mixing mortar or concrete, and with the same object in view, salt is added in amount depending upon the degree of cold. A common practice is to add 1 pound of salt to 18 gallons of water, with the addition of 1 ounce of salt for each degree below 32° F. Either of the above methods will give good results, but it should be remembered that the addition of salt often produces efflorescence. It seems to be a fairly well established fact that concrete deposited in freezing weather will ultimately develop full strength, showing no injury due to the low temperature.

TO FACE CONCRETE.

A coating of mortar one-half inch in thickness is frequently placed next the form to prevent the stone or gravel from showing and give a smooth and impervious surface. If in preparing this mortar finely crushed stone is used instead of sand, the work will more nearly resemble natural stone. A common method employed in facing concrete is to provide a thin sheet of metal of convenient length and about 8 or 10 inches wide. To this pieces of angle iron are riveted, so that when placed next to the mold a narrow space is formed in which the cement mortar is placed after the concrete has been deposited behind it, Fig. 1. The metal plate is then withdrawn and the concrete well tamped. The concrete and facing mortar must be put in at the same time so that they will set together. If the concrete is fairly rich, a smooth surface can usually be produced without a facing of mortar by working a spade up and down between the concrete and inner face of the mold, thus forcing the larger pieces of the aggregate back from the surface.

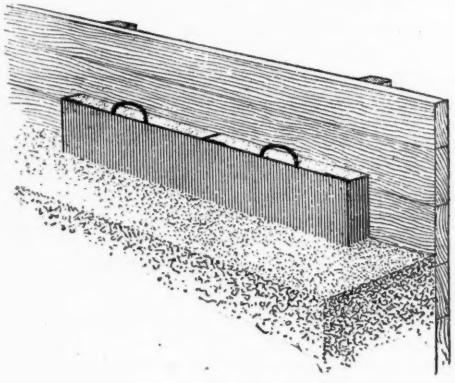


FIG. 1.

WOOD FOR FORMS.

Lumber used in making forms for concrete should be dressed on one side and both edges. The expansion and distortion of the wood due to the absorption of water from the concrete frequently make it difficult to produce an even surface on the work, and unless the forms are accurately fitted together more or less water will find its way out through the cracks, carrying some of the cement with it. A method sometimes adopted to minimize the effect of expansion is to bevel one edge of each board, allowing the edge to crush against the square edge of the adjacent board when expansion takes place.

In the case of a wooden core or inside mold, expansion must always be taken into consideration, for if neglected it may cause cracks or complete rupture of the concrete. Sharp edges in concrete are easily chipped and should be avoided by placing triangular strips in the corners of the molds. To prevent cement from sticking to the forms they may be given a coating of soft soap or be lined with paper. This greatly facilitates their removal and enables them to be used again with but little scraping. A wire brush answers best for cleaning the forms.

A sensitive galvanometer for use with a potentiometer in a position where there is much vibration is not easily found. The D'Arsonval suspension galvanometer is useless in such a place, and the ordinary small pivot galvanometer may not be sensitive enough for the work. A device recently tried with success was to remove the mirror and table from a student's microscope, and put an extension on so that the lenses could be brought over a pivot galvanometer. With this arrangement, which is always ready for use regardless of ordinary vibration, the potentiometer can be used for measurements to two-thousandths of one volt.

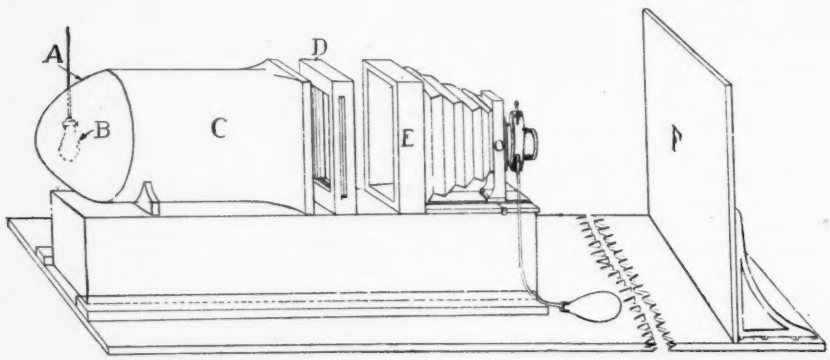
Aluminum paper, ordinary cellulose coated with powdered aluminum, is now being made in Germany as a substitute for tinfoil. It is used as a wrapper for food, and is said to possess the right qualities for preserving food. The paper itself is a kind of artificial parchment, prepared by treating ordinary paper with sulphuric acid. The sheets are spread out and evenly coated on one side with a solution of resin in alcohol or ether; then the powdered aluminum is applied, and the paper is finally pressed.

PHOTOGRAPHY.

A SIMPLE ENLARGING APPARATUS.

E. STANLEY THOMAS.

I propose to describe a simple form of enlarging apparatus that I have had in use for a number of months and which I believe will interest the readers of this magazine. The diagram will explain its construction quite clearly, I believe. *A* is an ordinary aluminum reflector, six inches in diameter; *B* is an ordinary incandescent electric light of sixteen candle power; *C*, a tin tube twenty inches in length, round at one end with a flange to receive the reflector as nearly light tight as possible and at the other end made square



to fit closely over the edge of frame *D*, which is an inch wide. This frame carried the negative in two sets of grooves, one at the top and one at bottom These grooves are wide enough to hold two thicknesses of glass so that one can use a film negative between two clean glasses. The front of this frame or the side next to the light, is fitted with pegs so that it takes its place against the frame of the camera just the same as the camera back which is removed for the purpose. The grooves in this frame are fitted with flat springs so that a single negative glass will be held firmly in place.

The camera is represented by *E*, and the easel upon which the paper is pinned is indicated by *F*. At the upper side of the tube near the light are a few small holes and in connection with some at the other end through on the under side, ventilation is secured. It is well to loosely drape a focussing cloth around the place where the reflector joins the tube, and again where the tube joins the camera so that there will be no leakage of light to strike the paper either at the join or through these holes.

The whole thing is placed on a table and joined up, the negative inserted and the focus secured on a piece of white card pinned to the easel. A trial strip of paper is exposed to get the time, and once found it is marked on the envelope of the negative for future reference. I generally stop down to U. S. 32, and the exposure is then from twenty to thirty-five for an 8 x 10 enlargement, and from forty-five to seventy-five minutes for a 16 x 20. I append a few notes from my negative envelopes:

No. 211 Very dense, enlarged to 8 x 10; U. S. 16; 35 minutes.

No. 147. Rather dense, enlarged to 16 x 20; U. S. 32; 65 minutes.

No. 279. Average negative, enlarged to 16 x 20; U. S. 32; 45 minutes.

No. 301. Very dense, enlarged to 8 x 10; U. S. 32; 60 minutes.

No. 419. Fair negative, enlarged to 8 x 10; U. S. 16; 23 minutes.

My densest negative requires ninety minutes with U. S. 16 to obtain a 16 x 20 enlargement. I use Eastman's C (soft) platino bromide, as I find it best for this form of light. When I mark the exposure time on the negative envelope the size of the stop as well as the size of the enlargement is also indicated so that there will be no need to experiment when wishing to make an enlargement from the same plate at a later date. The camera I use is a 4 x 5 instrument fitted with a No. 2 Plastigmat of 6¼ in. focus.

I have made some very satisfactory enlargements with this simple piece of apparatus and would recom-

mend others to try one on the same lines. It is not hard to construct, and the cost is very moderate indeed. The convenience of being able to get all ready and then turn out the lights in the room and work without the discomfort of a dark room is made very simple by turning on an 8 candle-power ruby lamp lamp which hangs conveniently near. Fitting the lens with a cap glazed with ruby glass, even though it be a rough affair whittled out of wood and pasted over with black paper, would allow one to pin up the paper before making the exposure, and it would also serve as a ruby light in developing the paper by opening the lens to the largest stop. In developing by such a light one could simply swing the camera and its tin tube around so that the light from the lens falls where it is wanted. If the negative is a very dense one, remove it and then there will be nothing but the sheet of ground glass to obstruct the light before it passes through the ruby cap on the lens.

While this apparatus is not the most advisable where a large amount of work is contemplated, on account of the length of exposure required, it will be found entirely satisfactory to the average worker who makes but few enlargements from time to time. In fact, the length of exposure is an advantage, permitting, as it does, perfect control by shading or otherwise dodging the print during exposure.

PHOTOGRAPHIC NOTES.

There is a little trick in the mounting of prints that is well worth adopting. That is to say, it may be of advantage to those who mount their prints when dry. In my immediate household there are three aspiring amateurs, and among the lot there is owned about everything that is intended to make the following of photography easy. Long ago—five or six years, to be precise, one member bought a print roller, and for a time we could none of us do anything without it. But those days are gone and the roller is packed away somewhere with a lot of other outlawed truck, lanterns, etc., now voted of no earthly use. One of us happens to be in a place that does mounting and printing for professionals, and was surprised to see with what ease and celerity the prints were fixed on the cards. The operator despised the use of a roller and did the work excellently well with—what do you suppose?—a silver half dollar.

With this or a similar coin the print can be quickly rubbed into contact in every part much better, in my humble opinion, than is possible with the most expensive print roller. The abraded edges of the coin insures that every portion should be rendered in contact and all superfluous paste pushed outward to the edges. A smaller coin will answer in a pinch; in my own case I keep for the purpose an English penny, and one would be surprised to see how the image on it has worn down by a few years of use. For the past four years not one of us has used the roller and find that the coin serves every need in mounting. I have never seen this idea exploited, and assure the reader that it is something that will pay to investigate.

A tiny working model of a triple-expansion engine, made by Robert Bunge of New York, is perhaps the finest piece of skilled work of its kind that has yet been brought to the attention of our contemporary, the "Scientific American." The engine measures 3½ in. across the bedplate, and stands 3¼ in. from the bottom of the bedplate to the top of the cylinder covers. Every part is perfect. It is even equipped with the link reversing motion. With a steam pressure of 100 pounds, 7260 revolutions per minute are made, turning a screw 2¼ in. in diameter by 7 in. pitch. The high pressure cylinder is 5-16 in. in diameter, the intermediate cylinder 8-16 in., and the low pressure cylinder 10-16 in. The valves are of the regular piston type for all cylinders, and measure 5-32, 7-32 and 9-32 in. in diameter. The shaft, the crank and the crank-pins are all turned from one piece of steel, which in itself is rather a neat piece of work. The eccentrics are split, and are exact miniature duplicates of those used on engines actually in service. The nuts used in the construction of the model are for the most part a fraction less than 1-16 in. in diameter. The studs are a little less than 1-32 in. in diameter, and are threaded at both ends, one end screwing into the machine, and the other receiving the nuts. The crossheads are made of steel and are fitted with brass shoes that can be taken off whenever wear occurs. The steam pipe is ⅛ in. in diameter, and the exhaust is 3-16 in. in diameter. The maker may well claim for this model that it is the smallest triple-expansion engine in the world.

In cleaning a fountain pen it is a great mistake for those experienced in such matters to attempt to take all the elements apart, owing to the difficulty experienced in putting them back in their correct relative positions. It is also a difficult matter to cleanse the minute passages thoroughly and free them from foreign matter which will get there, and which becomes hardened and obstructs the flow of ink and air. The simple device now explained is most effective in its action. It consists of one of the little pipette tubes supplied with fountain pens, fitted into and passed through a cork slightly tapered. This is placed in the water-supply tap, with the result that a fine jet of water is produced, issuing from the point at a pressure so great that if the point section of the pen be unscrewed and the jet allowed to play into the passages, all impurities will quickly disappear and the pen be thoroughly cleansed.

Every amateur mechanic who wishes to keep posted should regularly read AMATEUR WORK.

INSTALLING GASOLINE ENGINES.

It is the usual thing for the average purchaser of a gasoline engine to hunt up some corner in which to put his engine so as to be out of the way. Now this is one of the biggest and most expensive mistakes one can make, for as soon as some small screw gets loose in the far corner, the engine, salesman and manufacturer are consigned to a warm place, simply because the present owner has not left enough room to make any small adjustment necessary in every engine and and piece of machinery; therefore it pays always to install the engine in a light, dry place, easy of access and with sufficient space all round it to handily reach all parts and give plenty of room for turning the flywheels in starting. Whenever possible, place the engine on the ground floor. If placed on an upper floor the necessary provision should be made to avoid vibration from the engine; if installed in the basement place it in the best light.

Without a good foundation an engine may be expected to give more or less trouble from vibration as it is subjected to forces, suddenly and repeatedly exerted, which produce violent reactions on the foundations. Care should be taken to excavate down to good soil and to line the bottom with a substantial thickness of concrete in order to form a single mass of artificial stone. The foundations then may be built up of either concrete, brick or stone. Anchor plates should be extended to the bottom of the masonry and fastened so as to prevent turning while screwing up the nuts. Place gas pipes or tubes with an inside diameter twice the diameter of the bolts around them, while the foundation is being built; this allows the bolts to be adjusted, and any variations between the tubes may be filled with thin cement after the engine is set.

The top of the foundation should be finished perfectly flat and level with a dressing of cement, and after this is thoroughly dry the engine may be placed in position. When bolting down the engine, it is better to draw each nut down a little at a time until all are tight and thus avoid straining the engine crank. After the nuts are drawn tight, if the crank turns unreasonably hard without loosening the main bearing caps, it may indicate an uneven foundation, causing a strain in the engine bed casting.

When setting up large engines, especial care must be taken to avoid straining the bed castings. Foundations hung from an upper floor, or built upon it, should be placed as close to the wall as possible. For the smaller sizes of engines it is a good plan to lay wooden beams on the top of the foundations and then to place the engine on the top of them so that when the frame is bolted down it beds itself into the timber. The timber cap often saves an annoying vibration when it can be overcome in no other way.

All the connections should be as short and as free from turns as possible, and no mistake can be made by having plenty of unions, so as to disconnect with ease. The gasoline tank should be set as near to the engine as is convenient, and with the top of the tank preferably not more than a foot or two below the base of the engine. In cases where the gasoline tank must be set from forty to fifty feet away, it is necessary to place a check valve in the suction pipe near the tank; both suction and overflow pipes must have a gradual rise all the way from the tank to the pump and should be as straight as possible to avoid the air traps, which prevent a steady flow of gasoline. It is most essential to clean thoroughly all pipes and fittings before putting together, by hammering lightly to loosen any scale and washing out with gasoline, as solid matter of this nature may be responsible for some of the simple but hard to get at troubles common to gasoline engines.

Shellac is best for joints in gasoline piping, but when this cannot be obtained, common laundry soap will answer the purpose just about as well. In some cases it will be found advisable to use gravity feed instead of a pump, and the foregoing remarks are applicable with the exception of the tank, which must be so arranged that its lowest point is slightly above the generator valve.

The exhaust pipe must be of full size, free from turns and short as possible, the shorter the better, and the more economically the engine will run. It will be found advisable to place the muffler as close as possible, setting it carefully so as to avoid any strain on the valve casting. Keep both muffler and exhaust piping away from combustible material, and never turn the exhaust into any chimney or flue.

There are two general methods of supplying the water, the first being that of the cooling tank, commonly used with small engines. For convenience in piping the tank should be slightly elevated, and both pipes, having as few bends as possible, should slope from the tank to the engine, a valve being placed in the bottom pipe near the tank. By using a circulating pump, fitted to the engine or shaft, water may be used from an underground cistern or tank.

The other method is to use a continuous stream of cooling water from the city water-works or other source. When city water is used it is a good plan to have a break and funnel inserted in the drain pipe so that the current of water flowing through the cylinder jacket may be seen. For making joints in water pipes either thick lead or graphite may be used with almost equal success. It may be well to place particular emphasis on the fact that it will pay to get into the habit of always shutting off the water at the tank and draining the cylinder every time the engine is stopped—not necessary to do it in summer, but absolutely necessary

in winter—as a fair percentage of gasoline users know to their cost. "The Canadian Thresherman."

INFLUENCE OF THE EARTH IN WIRELESS TELEGRAPHY.

A good deal of interest has been shown recently in the statement that grounding a wireless telegraph station impairs considerably the efficiency of the station. The London "Electrician" in its issue of December 29, gives an abstract of a recent German paper by Herr J. S. Sachs, detailing the author's experiments to arrive at some definite conclusions in this matter. The work was suggested by Prof. Drude, and the system employed was due to the latter. It consisted of a primary circuit containing a spark-gap and a secondary circuit with its ends connected, respectively, to an air wire and a balancing capacity. The primary was a single turn of thick wire interrupter with a spark-gap. Its condenser was made of lead-foil fastened to a glass plate. The secondary was inside the primary and possessed ten well insulated wires wound in a single layer on an ebonite ring 8.7 centimeters in diameter.

The air wire consisted of a brass tube three metres long and 1.4 centimetres in diameter. The balancing capacity was a metal plate. The coils were designed to resonance, and the wave-length was computed to be thirty-one metres. The receiver differed from the sender only in having a constantan-iron thermo-couple in the position of the sender's spark-gap. The experiments were generally carried out in the open court in front of the Physical Institute of Giessen. The distances between sender and receiver varied from twenty-five to fifty metres. Readings were taken by galvanometers placed inside the institute building, to which wires were run from thermo-couple. In order to make allowance for the variableness of the energy radiated from the sender a coil called a standard coil, not in resonance with the sender, was kept in a fixed position relative to the sender's winding and was provided with a thermo-junction similar to that in the receiver. This junction was also connected to a galvanometer.

The mode of experimenting was to pass a current through the induction coil for the same period in each observation of a set. The deflections of the galvanometers connected with the two thermo-couples, divided the one by the other, gave the figures which were used in drawing conclusions.

In this manner were investigated the effect of varying the relative positions of the various parts of the sending apparatus, and the effect of symmetry of the two ends. Another series of experiments was performed to contrast the behavior of the receiver when sender and receiver were wholly insulated, with its behavior when the balancing plates at both ends of the thirty-metre stretch were connected to a plate buried one metre in the ground. When insulated the balancing-plates were one metre above the ground. It was found that the readings of the galvanometer were about twice as great when the whole apparatus was insulated as when the apparatus was earthed.

In order to examine the influence of the earth on the propagation of waves the author used the principle that this influence must alter with alteration of the apparatus above the ground. In dry, frosty weather, with air wires vertical and balancing-plates horizontal the maximum efficiency occurred when the apparatus was three metres above the ground. The effect at this height was more than four times the effect when the plates were only ten centimetres above the ground. On the other hand, in wet, cloudy weather, the maximum occurred at about one metre elevation, the effect at this height being about two and one-half times the effect at the height of ten centimetres. In both cases the maximum value was maintained with slight change, on further raising the apparatus to four or five times above the ground.

Experiments conducted to show the effect of distance on transmission gave values obeying the inverse square law. The distances varied between twelve and twenty-four metres.

The author's conclusions are stated thus: The earth's surface is, for waves of thirty-one metres, a strong absorbing and a weak reflecting medium. The connection to the earth of sender or receiver is greatly prejudicial to transmission. Insulating it is decidedly favorable. It is desirable to install the apparatus as high above the earth as possible. The integral effect at the receiver varies inversely as the square of the distance of transmission.—"Electrical Review."

The waste heat from a boiler furnace that escapes through the chimney is considerable, and to some extent unavoidable, for if all the heat were utilized, the chimney would not draw, since it is the heat in the chimney which first produces the draught in the furnace necessary for burning the fuel. Nevertheless, too much heat escapes by the chimney in most cases. A method recently patented professes to rectify this defect by bringing the flue containing the products of combustion to the place where the steam is applied before it passes into the chimney. The air, steam or hot-water and feed-pipes are passed through this flue, so that the heat contained in the gases of combustion prevents radiation from the pipe in question and contributes to the heating of the air, water and steam.

Polished aluminum has a slightly bluish tint like tin, but this can be improved. In polishing aluminum the grease is removed with pumice stone, and then is used an emery paste mixed with tallow, forming cakes which are rubbed on the polishing brushes. Finally, red polishing stuff, moistened with oil of turpentine, is used.

AMATEUR WORK.

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MARCH, 1906.

Wireless telegraphy has occupied a prominent place during the last few years in the public and trade press. In its early days most extravagant claims were made as to its field of operation, but these have gradually given place to more moderate statements, as actual experience has shown the limitations of this method of communication. Even at this time it is too early to definitely state what future developments may bring about, and those most familiar with the subject have adopted a waiting attitude, suspending judgment until some points are more definitely determined or new inventions superseded the imperfect devices at present in use. This much has been definitely settled; that this system of communication is entirely practical within certain limitations, and of sufficient usefulness so that inventors will continue to give it the attention needed to work out efficient devices. The financial aspects are another matter, however, and not until the numerous disputes regarding the invention of certain important devices have been settled will promotors' claims be accepted by the investing public. The small investor will probably find it to his best interest to let those assume the risks who have money, the loss of which will not be ruinous.

It would seem hardly necessary to call the attention of readers of this magazine to the benefits to be derived from following a hobby of some kind, as the mere fact that they are readers is evidence of some such pursuit. The many friends of these readers, however, may not have been made alive to the advantages which accompany the study and work in some special line, and it is these friends we desire to reach and make acquainted with this magazine.

We hope, therefore, that the magazine will be shown to all friends of readers who would be interested in it, as we are very desirous of largely increasing the circulation during the present year. This will, in turn, enable us to increase the size of the magazine, which we shall do as soon as the conditions will permit. The large number of subscriptions received during the past few months are encouraging evidence that our efforts are being appreciated and we again extend our thanks to the many who have so kindly aided us in this way. Keep up and increase the good work and we will try and show our appreciation through the columns of the magazine.

The "American Society of Model Engineers," is nearly ready to begin operations. Many of the officers for the first year have been selected and the work planned for the same period. Many additional letters have been received expressing interest, so that the number now enrolled is over 300. This is very encouraging, and once active operations are begun, the number will increase rapidly.

Do not forget to enclose stamp with inquiries for which a direct answer is desired.

Have you the new premium list? If not, send a postal, as it contains many new and useful tools.

"I never saw an ignorant man that didn't say that 'book larnin" was useless, and condemn all colleges, and then go out and work for a dollar and a half a day, while the educated man makes from five up."

READING COVERS AND PORTFOLIOS.

G. W.

The materials required are "bookbinders' millboard," some tape or narrow ribbon, various sheets of paper and some ordinary wheat-flour paste. The tools are a T-square, a straight, flat ruler, a sharp-pointed knife, a pair of scissors and a paste-brush. For covering one can use leather or cheaper substitutes, such as buckram and printed cretonnes or linens. Buckram is the best for the joints of the portfolios, and as a complete covering, if it is required to decorate when finished by the pen or brush. It is hard, with a smooth texture, and possesses the great advantage of not stretching or shrinking to any appreciable extent when paste is applied to it. Indeed, this latter attribute is so important that a word of warning may come in here—to test any other material before using it, and to discard it if it stretches or shrinks when wetted.

To begin with the practical construction: First make some thick wheat-flour paste. For this the flour should be mixed slowly, with cautious additions of a few drops of cold water until it is as smooth as cream. Then add quickly some boiling water in which a teaspoonful of powdered alum has been previously dissolved. Stir it constantly as the water is being added, and then pour back the whole into a saucepan and keep stirring it over a fire until it thickens to the required consistency.

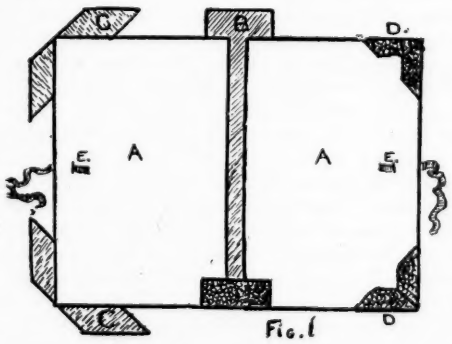


Fig. 1

The result is a firm, adhesive substance that, owing to the presence of the alum, will keep several days. Corrosive sublimate, a far more powerful antiseptic, is such a deadly poison that it cannot be recommended; a few drops of oil of cloves, however, will assist in its preservation and impart a fragrant odor to the paste.

It is necessary to have a firm, pointed steel blade—an ordinary penknife will do, but a shoemakers' knife is better; also a flat ruler, with a metal edge if possible, and some smooth boards for pressing the finished work, with a few bricks or other weights, unless a regular napkin press be available.

As the first stage of the process is somewhat "messy," it is best to make a good batch of "carcasses" in useful sizes, and keep them ready for after decoration when needed. Having decided upon the size, first, with the assistance of a T-square, mark your lines at true right angles upon the cardboard. Then, laying the piece flat upon a wooden board or, better still, upon a piece of glass, place the metal edge of your ruler to the pencilled line. Now, pressing very firmly upon the rule with the left hand, run a sharp-pointed knife lightly down upon the edge of the ruler; repeat the cut, using more pressure again and again, until the severance is made. The process needs boldness and care, or a slice of one of the fingers of the left hand may easily be detached with the cardboard if the knife should slip.

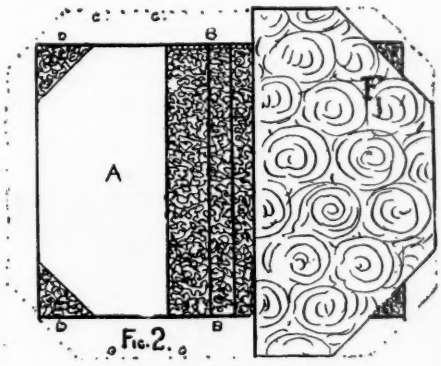


Fig. 2.

We will suppose a reading cover for a single number of a magazine is the subject of the first trial. For this two boards 9 x 11½ will be needed. This size is a quarter of an inch larger than the page each way. Next cut the pieces of paper for lining the inside of the covers the exact size or the page, 8¾ x 11. Then cut off a piece of the fabric, whether it be bookbinder's muslin, the "buckram" specially recommended, or ordinary stiff linen, such as that used for rolling window blinds, 14 x 3, and another of the same material, 10 x 3. Now paste these strips very thoroughly, allowing each to remain a few seconds before going over it again with the paste-brush.

Lay the first with its moistened side uppermost upon a flat surface. Place your two pieces of cardboard (*AA* Fig. 1) parallel upon this strip, *B* Fig. 1, remembering (and this is very important) that the width you allow between them will represent the holding qualities of the finished portfolio. For a single number let them be not over a quarter of an inch apart, parallel with each other and with the edges of the strip; see also

that they leave equal portions of the strip top and bottom for turning over. Now turn over these pieces and lay the strip 10 x 3 (which should be at hand ready pasted) to meet the turned over ends of the first strip, and thus complete the inside of the hinge. Lay a sheet of paper right over the strip and rub it with firm pressure to make the pasted material adhere smoothly; turn it over and rub down the other side in the same way. If properly done, the result is a rough portfolio, the complete foundation for all the after decoration, whatever it may be. To strengthen the corners, pieces of the same material used for the back strip may be applied, *CC*, Fig. 1. These turn over as shown in *DD*, Fig. 2, or covered over entirely, they improve both the finish and the lasting quality of the portfolios. They are not needed, however on small portfolios, as, unless skilfully applied, they are apt to produce a clumsy appearance. Their proportionate size in *CC*, Fig. 1 has been purposely exaggerated to explain their shape.

Having proceeded so far, if you intend to finish the work in the ordinary common style, paper of any variety, whether plain or previously decorated, should be the shape *F* in Fig. 2, and pasted on as there shown. It will be seen that the paper covers some of the material used for the back and corners; so, in planning out your materials, allowance must be made for this

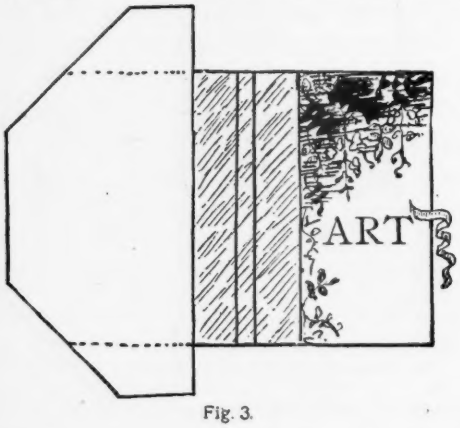


Fig. 3.

necessary overlapping. A quarter of an inch is sufficient, but it is better to allow too much than to find by too great economy you have spoiled the whole.

When the whole portfolio is to be covered (with a patterned silk or linen, or a plain material for decorating) it is called "whole binding," and a shape shown by the dotted lines *GG*, upon Fig. 2, will be required. For another style, known as "Roxburgh," or "quarter-binding," shown in Fig. 3, the material used for the sides covers the corners, but yet allows the back strips to show; in this instance the back piece is arranged to be much wider than for the so-called "half-binding" of Fig. 1.

It is often impossible to mount thin silk directly upon cardboard; indeed, it should never be attempted without a previous covering of white paper, if the silk be white, or a suitable color to match in other cases. If a sheet of paper be pasted and the silk laid smoothly on and dried under pressure, it may then be used as easily as ordinary paper. This, however, sometimes stains the silk. The best plan is to cut the paper to the exact size required, to gum the silk to it, using a very thick mucilage at the edges only. This, when dry, may be cut to a straight edge—otherwise always a difficult task—and applied as readily as if it were a firm fabric. Finally, paper slightly smaller each way than the cover, should be neatly pasted on the insides.

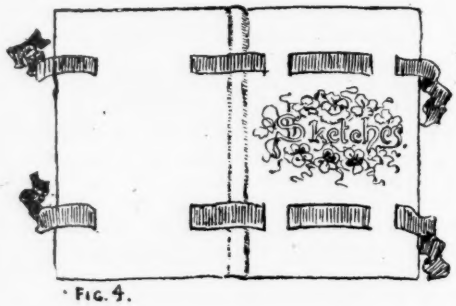


Fig. 4.

How strings to tie the portfolio should be affixed is shown in Fig. 1, although they are really not applied until the stage shown in Fig. 2; but it was easier to explain the manner of their insertion in that diagram. After the outer covering is pasted on, but before the inner lining sheet is fixed to each cover, a slit should be cut with a sharp-pointed knife right through the cardboard. Through this the ribbon should be passed and its loose end pasted down. The lining paper may be trusted to secure it finally. When wide ribbons are used as decorative features of the cover, Fig. 4, they are passed through in the same way. This needs some care, but can be accomplished with a little patience. Where the fabric is too rough in texture to permit lettering by ink or paint, it is best to embroider the title required on the ribbon. Paint it thereon in opaque water-colors after it is fixed in place.

When a portfolio is intended to preserve a book, such as a paper-covered novel, and not to be used at will for a variety of volumes, a preparatory stitching of the volume to be encased is desirable.

But if the cover is to be used for blotting-paper, for a railway time-table, or the successive numbers of a periodical, it is best to arrange strings of elastic at the back to tie the contents in place. If some narrow ribbon be passed from the inside through the back piece about half an inch from the top and from the bottom and tied in the middle of the open pamphlet or magazine, the contents are easily removed and replaced at pleasure.—Arts and Crafts, London.

EASILY MADE WEATHER INDICATORS.

N. SHARPE.

The primary factor in all kinds of weather is the moisture which is always present in varying quantity in the atmosphere. The second factor—the pressure of the air—depends upon the first. The average weight of the atmosphere is 14.7 lb. per square inch. The weight increases as the atmosphere becomes drier. This is easily tested by weighing a flask filled with dry air, and comparing the result with that obtained when the same flask is filled with a mixture of steam and air. The introduction of moisture will be found to reduce the weight. So it is with the atmosphere. When the weather is clear and the sky bright, there is very little water vapor mingled with the air; but when the sky is covered with clouds and wet weather is approaching, the air is laden with water particles, and is therefore lighter than usual.

It is here purposed to show the application of the above principle to the making of several kinds of weather indicators. The susceptibility of catgut to moisture is well known. This substance possesses the power of shortening its length and twisting when exposed to damp; and this twisting motion can be utilized in making a simple weather indicator that will provide amusement as well as information. It takes the form of a quaint little house with two doors, in one of which stands a woman and in the other a man. The latter comes outside when bad weather is threatened, and the woman retires, the reverse taking place when the weather is fine.

This effect is produced by means of a short piece of catgut suspended from the roof by one end and attached at the other to the moving framework below. The two figures are glued to the ends of a short wooden bar, in the center of which an upright piece is secured. The lower end of the catgut is then attached to the upright. Damp air causes the catgut to twist in one direction, while dry air causes it to twist in the other, thus turning the framework on a pivot, and changing the position of the figures. The figures are arranged according to the direction of this twist, which must be tested by experiment.

The property of catgut in altering its length when exposed to damp is utilized in another form of weather indicator, made as follows: Take a baseboard about 1 ft. square and 1 in. thick, and fit to the back of it two hanging plates. Mark two lines across the face of the board, one at each end, and about 1½ in. from the edge. These lines must be drawn so that they will be horizontal when the baseboard is hung in position. At a distance of 1½ in. from the side edge, measuring along the top line, insert a screw-eye, such as is used for picture hanging, having a ring about ¾ in. in diameter. Mark a dot 1½ in. from the screw-eye, and four more along the remainder of the line, leaving 1¼ in. space between them. Now, measuring from the side edge as before, mark a dot on the bottom line 2¾ in. from the edge, and finish off the line with four more dots 1¼ in. apart.

Now get ten little brass pulleys, about ⅝ in. in diameter (these are used in venetian blind work, and can be obtained at a hardware store), and the same number of button-headed screws, about 1 in. long, with shanks an easy running fit for the holes in the pulleys. Then insert a button-headed screw carrying a pulley at each dot in the top line—five in all. Screw a pulley the same number in the lower line, where the position of the pulleys falls between that of the pulleys in the top line. About 9 ft. of 1-16 in. catgut, as used for suspending clock weights, will be required. Tie one end securely to the screw-eye in the top row, and take a turn under the first pulley of the bottom row; then up and over the top row of the first pulley, and so on. If the pulleys have been properly spaced, as directed, a free length of catgut will hang from the last pulley of the top row.

A lead pointer must now be made. Take a piece of heavy sheet lead and bend it double; place a piece of wire in the fold and close up with a hammer. From this cut a fairly long triangle, leaving the wired doubled edge for the base; the two remaining sides should be equal and should come to a point. Remove the wire from the bend and in its place pass through the free end of the catgut, which should be so tied as to bring the point of the weight about halfway down the board, the surplus catgut being cut off.

All that now remains to be done is to paste on the scale, which should reach from the last pulley of the top row to the bottom of the board. After fitting together it is advisable to take off the pulleys, etc., and give the board, including the scale, a coat of varnish. It would also be an improvement if the edges of the board were chamfered. When dry, reassemble the parts, taking care not to screw in the button heads so far as to cause the pulleys to jam.

The action of the indicator is very simple. Moisture in the air causes the gut to contract, which is at once indicated by the rising of the lead pointer, a sure sign of wet weather. In fine, dry weather the gut lengthens, and the slack is drawn down by the pointer.

The two indicators described, however, rely for their action upon the moisture of the air, and are not affected by atmospheric pressure. Another variety now to be described is more truly barometric and will, if properly read, indicate wind as well as rain. The general principle of this class of indicator depends on the fact that the volume of air enclosed in an elastic vessel

varies in proportion to the pressure of the outer air.

An instrument of this kind can be made from an old electric incandescent bath. Get a burnt-out lamp of fair size, and have at hand a fine-cut file and a basin of water. Holding the bulb so that the pointed end is under the water in the basin, file away the point, still keeping it under water. Very soon a jet of water will be seen rising into the globe. When this occurs, stop filing, but on no account lift the point out of the water. Hold the lamp steady until it contains enough water to weigh it down below the surface. Leave it there for about half an hour; then take it out, dry it, and hang it up, point downwards, by a string tied round under the cap. Wet weather will bring a drop of water of varying size to the outside of the point; in dry weather the glass will be quite dry. The cause of this action is that the gas which is always present in an old lamp bulb expands and contracts according to the atmospheric pressure. This expansion and contracton reacts upon the water, and the drop is exuded and withdrawn as the weather is wet or dry.

Another instrument of the same class is made from a tall, narrow bottle, a length of glass fine-bore tubing, some colored liquid, a cork to fit the bottle, and a strip of cardboard. After thoroughly cleaning the bottle, fit the cork, and when this has been adjusted, bore a hole centrally through the cork of a size to enable the tubing to fit tight. The tube, upon the fineness of whose bore depends the delicacy of the reading, should be about twice the length of the bottle. Bend the tube U-shape, by heating in a lamp or gas flame, so that the limbs are about 1 in. apart, and one limb about 2 in. longer than the other. Cut a piece of pasteboard to the same length as the short limb, and about 1¼ in. broad. Draw two lines centrally down the length, about 1¼ in. apart, and graduate a scale between them, from about 1 in. from the bottom to the same distance from the top.

Now push the long limb of the tube through the hole in the cork until the short limb is almost touching the under side; then secure the scale to the tube with a few stitches of white thread passing through the pasteboard and round the tube. This done, pour a colored liquid into the tube till it reaches about halfway up the scale in each limb. Now push the cork firmly into place in the neck of the bottle, with the tube and scale inside. Melt some sealing-wax and carefully spread it all over the surface of the cork and round the edge, as well as round the tube, to make it air-tight. On the approach of bad weather the colored liquid will rise in the long limb, because the air pressure outside will be slightly weaker than normal. For fine weather the liquid will sink in the long limb, the air being heavier. The action is explained by the fact that the bottle contains a fairly large volume of air, whose volume will vary more or less perceptibly with the variation of the atmospheric pressure.—"Work," London.

Renew your subscription before you forget it.

WANTED—LEVEL HEADED MEN.

You may be smart, shrewd, cunning, long-headed, you may be a good scholar, very clever—even brilliant—but are you sound? That is the question everybody who has any dealings with you will ask. Are you substantial, solid? Have you a level head?

Everywhere we see men who are very brilliant out of work, plenty of sharp men who wonder why they do not get responsible positions. But people are afraid of these one-sided, poorly balanced men. Nobody feels safe in their hands. People want to feel that a man in a responsible position can keep a clear brain and level head no matter what comes, that he cannot be shaken from his center no matter how much influence is brought to bear upon him. They want to be sure that he is self-centered, that he is sound to the very core. Most people overestimate the value of education, of brilliance, sharpness, shrewdness, which they think can be substituted for a level head and sound judgment.

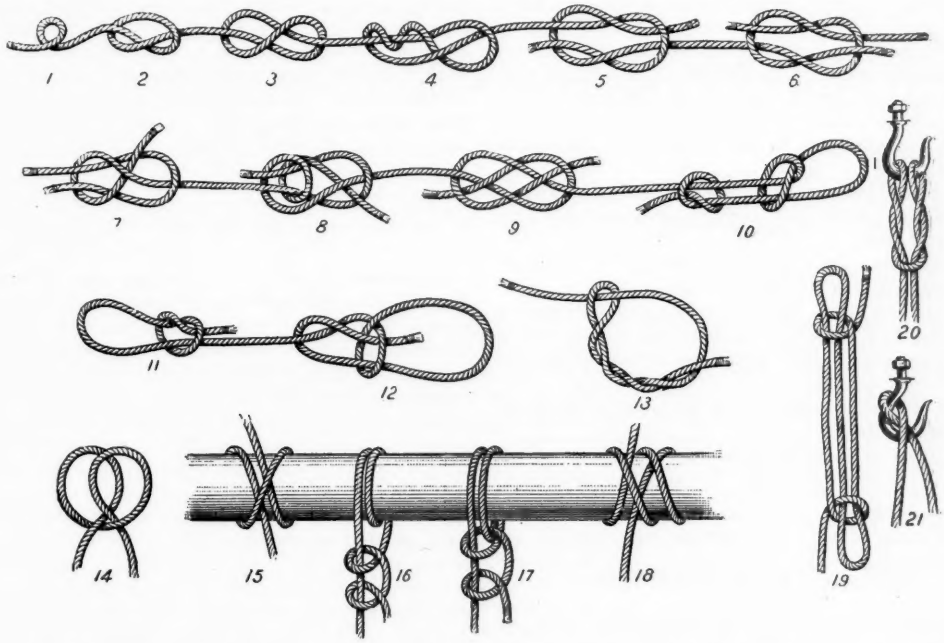
The great prizes of life do not fall to the most brilliant, to the cleverest, to the most long-headed or to the best educated, but to the most level-headed men, to the men of sound judgment. When a man is wanted for a responsible position, his shrewdness is not considered so important as his sound judgment. Reliability is what is wanted. Can a man stand without being tripped; and if he is thrown can he land upon his feet? Can he be depended upon, relied upon under all circumstances to do the right thing, the sensible thing? Has the man a level head? Has he good horse sense? Is he liable to go off on a tangent or to "go off half-cocked?" Is he "faddy"? Has he "wheels in his head?" Does he lose his temper easily, or can he control himself? If he can keep a level head under all circumstances, if he cannot be thrown off his balance and is honest, he is the man wanted.

The freezing system of tunneling is to be adopted in the construction of the new tube railroad for Paris at the point where the track will pass beneath the Orleans trunk railway. For various reasons, the ordinary shield system will not be suitable. The earth is to be frozen to a temperature of 30° below zero, so that the excavators can cut the tunnel without incurring any danger of collapse before the metal lining has been placed in position. The workmen, however, will experience some inconvenience while working at such a low temperature, but it is thought that this method offers the only solution of the problem.

Vast quantities of chalk are annually made into tooth powders. It is the base of most of the dentrifices. Mixed with the chalk as detergents are charcoal, cuttlefish bone and pumice. Bleaching salts and various acids also constitute parts of some dentrifices and constitute a grave danger to the teeth.

SCAFFOLD KNOTS AND HITCHES.

There is a great lack of knowledge among workmen generally with regard to the tying of rope for scaffolding, and when it is considered that during the erection of a building the workman lives, as it were, on the scaffold, sometimes poised in midair and in other dangerous positions where life and limb is jeopardized, it is most essential that the scaffold should be trustworthy and safe, and one of the factors of safety is the correct lashing and tying of the rope, with the manipulation of which the workman should be perfectly familiar.



As a chain is no stronger than its weakest link, so stability of the scaffold is dependent to a great extent upon the security of its knots; hence the importance of knowing the best one to use for the purpose required. Although scaffolds are generally erected by qualified men, yet there are occasions when the workman requires some adjustment or addition to the scaffold for a special purpose. He has then to undertake the alteration himself, and his knowledge of tying knots can be applied.

The knowledge one possesses in tying knots is not confined to the one vocation of scaffolding, but is useful in all departments of everyday life. A great number of knots have been devised for various purposes. The few here illustrated are those chiefly used in the erection of pole scaffolding and comprise nearly all that are necessary. The tying of these knots should be practiced by the uninitiated, for the process is inexpensive, as the back of a chair may be utilized, a small piece or or two of sash cord, with a little persistence, being all that is required to make perfect.

A very good proof that the lesson has been learned thoroughly is to tie each of these knots in the dark. The principles of a good knot are its facility in tying, its freedom from slipping and its being easily untied, says a writer in an English exchange. All knots will jam more or less when subject to a strain. In the diagrams here given the knots are shown open before being drawn taut in order to show the position of the parts. The names usually given and their uses are as follows:

1. Bight of a rope.

2. Overhand, or thumb knot, to prevent a rope running through the sheave of a block.

3. Figure of eight knot, used as No. 2.

4. Stevedore knot; is useful when the rope passes through an eye. It is easily untied after being strained.

5. Square or reef knot; this is the most useful knot for joining two ropes of the same size. However tight it jams it is easily "upset" and undone.

6. Granny, or thief, knot; this should not be used, as it will jam tight but not slip (as erroneously supposed), will not "upset," and consequently is difficult

to undo.

7. Single sheet bend, or weavers' knot; used principally for joining two ropes of unequal sizes more securely than a reef knot.

8. Double sheet bend; more secure than No. 7.

9. Carrick bend, for fastening the four guys to a derrick.

10. Flemish loop.

11. Slip knot.

12. Bowline, for making a loop that will not slip. After being strained this knot is easily untied. Commence by making a bight in the rope, then put the end through the bight and under the standing part, pass the end again through the bight and pull taut. This knot should be tied with facility by every one handling ropes.

13. Timber hitch; the greater the strain the tighter it will hold.

14. Clove hitch, consisting of two half hitches; used chiefly to tie ledgers to standards. This is the most useful of all the knots used in scaffolding on account of its simplicity and security.

15. Clove hitch, as No. 14, showing its application around a pole.

16. Round turn and two half hitches for securing a rope to a ledger, or for fastening the guys of derricks, shear legs, etc.

17. Fisherman's bend; used when a thick rope, such as a fall, is made fast to a ring.

18. Rolling hitch; used in a variety of ways, chiefly in making fast one rope to another that is held taut.

19. Sheepshank, for shortening a rope when the ends are inaccessible.

29. Catspaw, an endless loop, and used where great power is required.

21. Blackwaller; easily applied, but requires watching; has a tendency to slip.—"Carpentry and Building."

THE HEAT OF THE SUN.

The heat of the sun never penetrates more than 100 feet below the earth's surface, and at which depth the thermometer remains at 52° F. throughout the year, whether in the Arctic or tropical zones, says the "Mining World." Downward from 100 feet, every 66 feet means a gain of 1° of heat, and at 10,000 feet it is estimated water would boil. At a distance of 30 miles all rocks in the crust would melt. It is improbable that the same rate of temperature increase continues to the earth's center, because that would give a heat vastly beyond conception. We know that in the borings of mines heat increases with depth.

The large number of hot lakes and geyser springs, numerous volcanoes in various parts of the world, are certain indications that a vast amount of heat still lies beneath the earth's surface. Not long ago supposition was that the interior of the earth was a vast ocean of molten rock, surrounded by a cold crust, but later knowledge of physical laws has led to the belief that the earth is more rigid than a globe of steel of similar size. If the earth was a globe of molten material surrounded by a thin crust, it would be continually pulled out of shape by the attraction of the moon, and great tidal waves would be created on the surface by the surging molten mass within. While the interior of the earth is rigid, an exceedingly high temperature nevertheless prevails, and it continues in a solid state only by intense pressure.

If it were possible to strip off the cold exterior crust, the solid and heated interior would instantly become molten. It is most probable that there are local pools and reservoirs of molten materials in and under the crust. Whenever there is a local disturbance caused by the shrinkage of the crust and a release of pressure, we may suppose that pools of liquid rock are formed. Through fissures in the earth's crust such molten masses have in the past ages been forced up and spread over the surface. The lava beds of Arizona, New Mexico and other western points, the Palisades of the Hudson River, the Giant's Causeway in Ireland and numerous other occurrences, are remnants of ancient lava flows.

Laminated poles and pole tips are coming into increased use, and this, says "Power," is a feature of modern dynamo and alternator construction. For traction dynamos this construction is found to be of advantage, because the magnetism more quickly responds to changes of load. It is obviously of little avail to fit the engine with an elaborate cut-off and governing gear if the magnetism of the dynamo is sluggish. In the case of alternators, and to a certain extent of dynamos, lamination is of advantage is reducing eddy currents. Further, the designer is dealing with material which can be depended on to come up to a certain magnetic value. Unfortunately this is not the case with cast steel or cast iron. When the complete pole is laminated, the block is often cast into the yoke. This method, though cheap, is not so good as bolting on the poles, because the plates must be affected by the heat and can be insulated only with oxide. The molten metal would destroy paper or japan. For dynamos, pole shoes are usual, so as not to have the air-gap area too concentrated. The shoe also acts as a support to the magnetic coil.

The largest raindrops are about one-fifth of an inch in diameter. Their size has been determined by allowing rain to fall into a thick layer of flour, each drop forming a pellet of dough, and these pellets are compared with dough pellets obtained, it is said, from drops of known size delivered upon the flour by artificial means.

CARE AND MANAGEMENT OF BELTS.

W. A. DOW.

The object of this article is to bring before the readers of this paper a lesson on the care of belts and the placing of pulleys, adjustments and tightness.

In placing a belt around two pulleys, no rule can be given which will account for the stretch in the belt, since the stretch of a belt is variable in different belts of the same length. A belt should be cut slightly shorter than the measured length around the pulleys and it is evident that the length of a belt cannot be obtained exactly by calculation. In practice, to obtain the necessary length of a belt which is to pass around two pulleys already on their places upon the shaft, it is usual to pass a tape measure around the pulleys, the stretch of the line or tape being allowed for the stretch of the belt.

If the length of a belt for pulleys not in position is required, it may be obtained as follows: Suppose Fig. 1 represents the condition where the diameter of the large wheel is 36 in. and the diameter of the small wheel 18 in. and the distance between centers is 50 in.; then, $\sqrt{50^2 + 9^2} = \sqrt{2581} = 50.79$ in., the length of the belt on each side tangent to pulleys. This must be multiplied by 2 to get the length of both sides, to which must be added the half circumference of both the larger and smaller pulleys, or $50.79 \times 2 = 101.58$ in.; half circumference of larger pulley $= 18 \times 3.1416 = 56.54$; half circumference of smaller pulley $= 9 \times 3.1416 = 28.27$; therefore $101.58 + 56.54 + 23.27 = 186.33$ in. is the length of belt required.

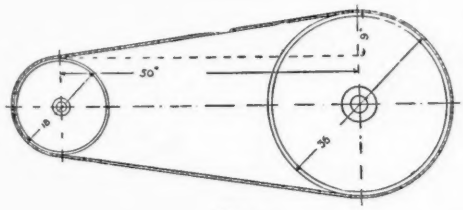


Fig. 1

The rule, therefore, is: Square the distance between center of pulleys and square the difference in radii of the two pulleys, add together and extract the square root. Multiply this root by 2 and add half the circumference of each pulley. The result will be the length of the belt. This will give a belt a little too long, but allows for a small amount to be cut out of the belt to give the necessary tension. Another rule is as follows: Add the diameters of the two pulleys, divide the result by 2, multiply the quotient by $3\frac{1}{4}$ and add twice the distance between the center of the shafts. The result will be the length of belt required.

The grain side of the belt should be placed next to the pulley, for with the grain side out there is a tendency to stretch and crack; this occurs especially when small pulleys are used, whereas if the grain side was next to the pulley the tendency would be to compress it and prevent either cracking or tearing. Very little of the belt's strength is lost by wearing away its weak side.

When two pulleys are placed one above the other, the upper pulley will have a grip due to the tension and weight of the belt, whereas if placed horizontally, the weight of the belt will fall equally on both pulleys and for this reason vertical belts of large size require greater tension on the pulleys to transmit the same power than belts placed horizontally.

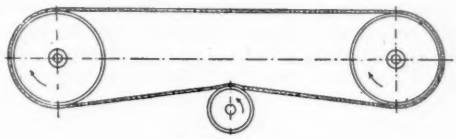


Fig. 2

As soon as motion is transmitted by a belt from one pulley to another, one side of the belt is under greater tension than the other. The side of the belt to be the most strained is the drive side, which is the side that approaches the driving pulley. The slack side is always that which recedes from the pulley. In some cases the sag of the belt is so great that the arc of contact on the drive pulley is not sufficient to prevent slipping of the belt. When this occurs, which is usually when the slack side is the lower side of the belt, an idle pulley is placed between the two main pulleys, as shown in Fig. 2.

As will be noticed, this pulley takes up the sag of the belt and allows a longer arc of contact to be made on the drive pulley. When the direction of rotation of the driven pulley is required to be reversed from that of the driving pulley, the belt must be crossed, as shown in Fig. 3. It is evident that cross belts have a greater arc of contact and a greater transmitting power than open belts and the slip is less, but the life of the belt is shortened on account of the two sides of the belt being in constant use.

When a belt connects two pulleys whose planes of rotation are at an angle one to the other, it is necessary to have the center line of the belt approach the pulley in the plane of the pulley's revolution irrespective of the line of motion of the belt when receding from the pulley, as shown in Fig. 4. This figure represents what is known as a quarter-twist belt. *A* and *B* are the two pulleys whose planes of revolutions are

at right angles, the belt traveling as denoted by the arrows. The center line of the belt is in the plane of rotation of *A* on the side on which it advances to *A*. Now, if the position of the pulleys is changed, the same rule applies. It is evident, therefore, that the belt motion must occur in the one direction only and shafts at any angle one to another may have motion

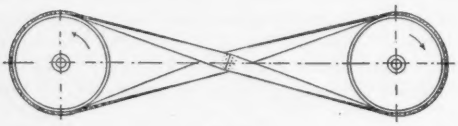


Fig. 3

communicated from one to the other by a similar belt connection, providing a line at right angles to the axis of one forms also a right angle with the axis of the other.

The axes of shafts may be set at any angle to the plane of rotation, provided that the axle line of pulley *A* at right angles to the imaginary line *C*, which is at right angles to the axis of the shaft of pulley *A*, and the side of the driving pulley which delivers the belt is in line with the center line of the driven pulley.

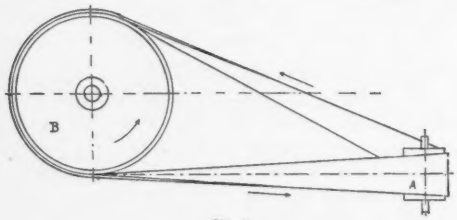


Fig. 4

It sometimes occurs that these provisions cannot be carried out, and in those cases pulleys to guide the direction of the motion of the belts must be employed. Thus, in Fig. 5, an arrangement of guide or mule pulleys is shown which are placed at the intersection of the middle planes of pulleys *A* and *B*. The dotted

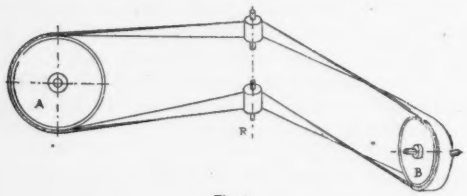


Fig 5

line TR shows the intersection of the two planes. The axes of the mule pulleys are made to coincide with this line, in which case the belts will have the suitable directions and can be run in both directions.

An arrangement of guide pulleys by which two pulleys not in the same plane are connected, is shown in Fig. 6. As will be noticed, the arc of contact of the smaller pulley *A* is increased by the use of the two idlers *C* and *D*, and the belt may be run in either direction. From the foregoing it can be seen that belts can run in any direction, providing pulleys are placed in proper positions.

It often happens when new belts are required, the width necessary to transmit a certain horse power must be known. This can be determined by the following formula:

$$W = \frac{800\ H}{S}$$

where W = width of belt in inches, H = horse-power to be transmitted and S = speed of belt in feet per minute. If the width is given and it is required to find the number of horse-power the belt is capable of transmitting, the formula becomes

$$H = \frac{WS}{800}$$

Suppose, for example, a belt is 8 in. wide and its speed is 2000 ft. per minute, then $H = (8 \times 2000) \div 800 = 20$ horse power. This rule is used when both pulleys are of the same diameter. When two pulleys are used of different diameters, multiply the length of the belt in contact on the smaller pulley by 360 and divide the product by the circumference of the pulley. The

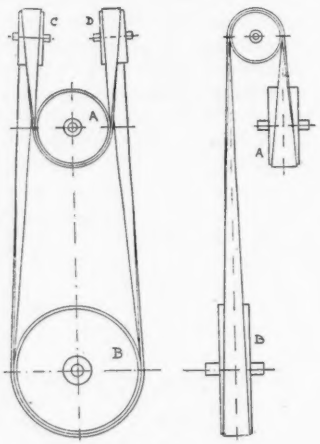


Fig. 6

quotient will be the arc of contact. After the arc of contact is found, subtract it from 180 and multiply the remainder by 3. This last result is to be added to 800 and the sum used when computing the power of the belt. The following article shows how the arc of contact is used when computing the power of the belt. Suppose the small pulley to be 24 in. in diameter and the length of contact 30 in., then $(30 \times 360 \div (24 \div 3.1416) = 143$ degrees. Then $(180 - 143) \times 3 = 111$ and $800 + 111 = 911$, which is the sum to be used in the horse-power formula. Suppose under those conditions

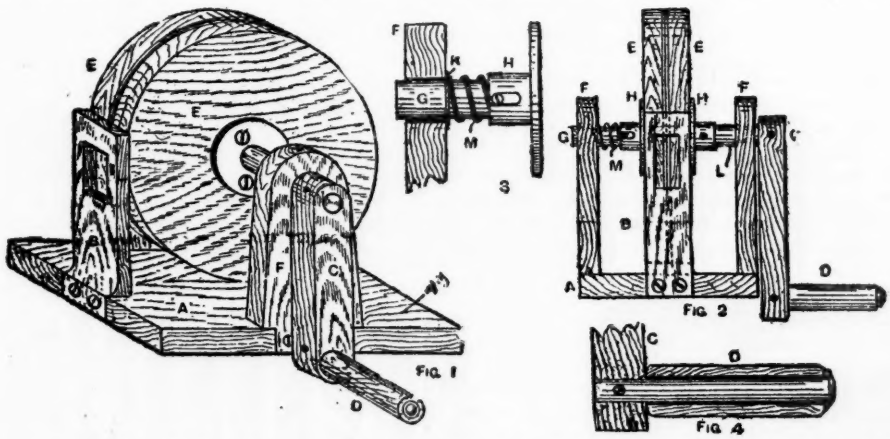
an 8-in. belt is used which runs 2500 ft. per minute, then according to the formula $(2500 \times 8) \div 911 = 21.9$ horse-power.

In all the above cases, a single belt was implied in the calculations. When a double belt is used it will transmit $1\frac{1}{2}$ times the power of a single belt, and in order to find the width of a double belt, multiply the width of a single belt by $\frac{2}{3}$. For instance, if it requires a single belt 15 in. in diameter to transmit a certain horse-power, it will only require a $\frac{2}{3} \times 15 = 10$-inch double belt to do the same work.—"The Practical Engineer."

A KNIFE CLEANING MACHINE.

C. B.

The knife-cleaning machine illustrated at Fig. 1 is a strong and serviceable article, and can be made without the aid of any expensive tools. Fig. 2 is an elevation of the machine. The baseboard *A*, the central upright *B*, and the crank *C*, which carries the handle *D*, are made from 1-in. stuff, while the two wooden discs *E* and the uprights *F*, which carry the spindle *G* are of $\frac{3}{4}$-in. stuff. The pieces are in single thickness; but to prevent warping it is advisable to make the baseboard and the wooden discs of two thicknesses, with the grain crosswise, glued and screwed together. The baseboard having been planed up to 1 ft. x 7 in, the uprights *p* should be cut out; these are 3 in. wide where the spindle enters, increasing to 4 in. at the bottom, with an extra 1 in. to be recessed in the baseboard. The center of the spindle is to be $5\frac{1}{2}$ in. from the baseboard.



These uprights must be quite vertical and are secured to the baseboard with two screws each. The holes to receive the brass tube bushes which form the bearings of the spindle are next marked out and bored. These holes should be perfectly in line with each other and should be made a driving fit for the tubular bushes, which must be nicely smoothed inside. The spindle *G* may be of brass or iron, $8\frac{1}{4}$ in. in length and about $\frac{3}{4}$ in. in diameter. To this is fitted the two flanges *H*, (ceiling plates, as used in gas fitting, will answer very well); they should be a good fit on the spindle, as any looseness will cause the discs to which they are attached to run out of truth.

The wooden discs, 10 in. in diameter, should next be marked out with compasses and cut with a pad saw as close to the lines as possible, and afterwards smoothed round with a rasp or rough file. Turning them on the lathe, if one is available, would of course make a better job. From the center strike out circles slightly larger than the greatest diameter of the flanges and screw the latter on central. The holes to fit the spindle are continued through the discs, which are then mounted on the spindle to see if they run true. The disc to the right should push on and is held by a set screw.

The other disc is made a sliding fit, the fixing in this case being by means of a $\frac{1}{4}$-in. headless screw, tapped into the spindle, working in a slot cut in the cylindrical part of the flange, as shown in enlarged detail at Fig. 3. The disc can thus be pulled away a short distance from the other to allow of the introduction of the cleaning medium. A strong spring *M* is coiled round the spindle to keep the discs close together; a washer *K* being interposed between the spring and the upright. If the discs do not run true on the spindle a true line can be marked on the periphery by holding a pencil or a knife edge against it while the spindle is

revolved, the surface then being planed true to the line. When true, the disc should be covered with hard felt, attached with glue.

The crank *C*, Figs. 1 and 2, which is 8 in. long by 1½ in. wide, is bored at one end to fit tight on the spindle and at the other to take a ¼-in. rod on which the handle *D* is fitted, the centers of the holes being 6½ in. apart. The handle, a sectional view of which is given at Fig. 4, can be made from a piece of stout broom-handle, which should be lined with brass tube to fit over the ¼-in. rod. At one end of the rod a rivet head is formed, then a washer is slipped on and then the handle.

The other end is forced into the hole in the crank. A ¼-in. pin put through this and another through the spindle, securely holds the parts together. A washer is inserted between the crank and the upright to prevent them from rubbing together. Side play of the spindle is prevented in one direction by the crank of the handle, and in other directions by a piece of brass tube, similar to the spindle bushes, cut the correct length, and slipped on the spindle *L*, Fig. 2, when putting the machines together.

The central upright *B*, Figs 1 and 2, which is 2 in. wide, is next fitted to just clear the discs, the thickness being reduced to ¼ in. after it leaves the baseboard. See Fig. 1. The opening in the upper part is 1 x 2 in., the top edge being level with the center of the spindle. The knife to be cleaned is passed through this opening between the discs.

Screw holes for clamping-down purposes are made to suit the table or bench on which the machine is to be used; when fixed, the edge of the baseboard should be flush with the edge of this table, so as to allow of the proper working of the handle.—"Work," London.

A VILLAGE TELEPHONE EXCHANGE.

LAWRENCE V. STEVENS.

III. Running Line Wires—Fuse Board.

In installing the switchboard at the central office in the general store, the experts from the supply house will attend to all the details of wiring and testing out the circuits in the board. Lines representing the full capacity of the board are brought out in pairs to a connecting strip of maple wood, fastened to the wall at the point of entrance for all outside wires. A cross frame of oak fastened to the roof of the store

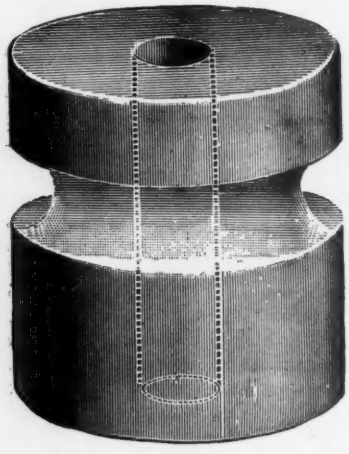
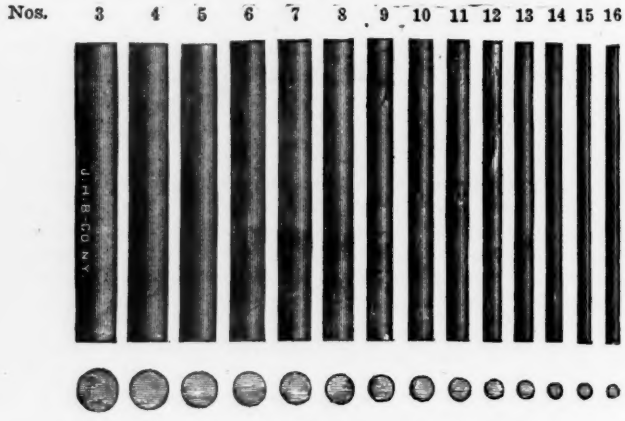


FIG. 1.

will answer for the terminal for all outside lines. On this frame the galvanized line wires are fast to insulators, Fig. 1, and the ends of each wire soldered to well insulated copper wire, No. 14 gauge, of the brand often spoken of as Okonite or Kerite wire. This rubber-covered wire enters the building through one duct or hole cut in the wall and hooded over to prevent the entrance of rain or snow.

The insulated wires are connected in proper position upon a fuse frame, which is supplied by the company furnishing the apparatus, and which is illustrated in



WIRE GAUGES.

Fig. This frame serves to protect the switchboard should wires become charged with electricity from lightning or a cross with high potential circuits. Each wire is fused with standard mica fuses, which blow at any excess of current over one ampere. Also as an

extra preventative each wire fuse terminal is connected to one block of the carbon arrestor, the opposite end of which is grounded. The blocks being separated a small fraction of an inch by a thin slip of silk cloth or mica, do not interfere with the path of the ordinary current through the fuse, but should oscillating currents of high arching power reach the fuse, the discharge is carried through the grounded carbon to earth, thus saving the switchboard from harm. The circuit of this device is plainly shown in Fig. 3. All connections made on strips are soldered, with the exception of the fuses which are fastened securely under screw heads and washers.

BRACKETS.

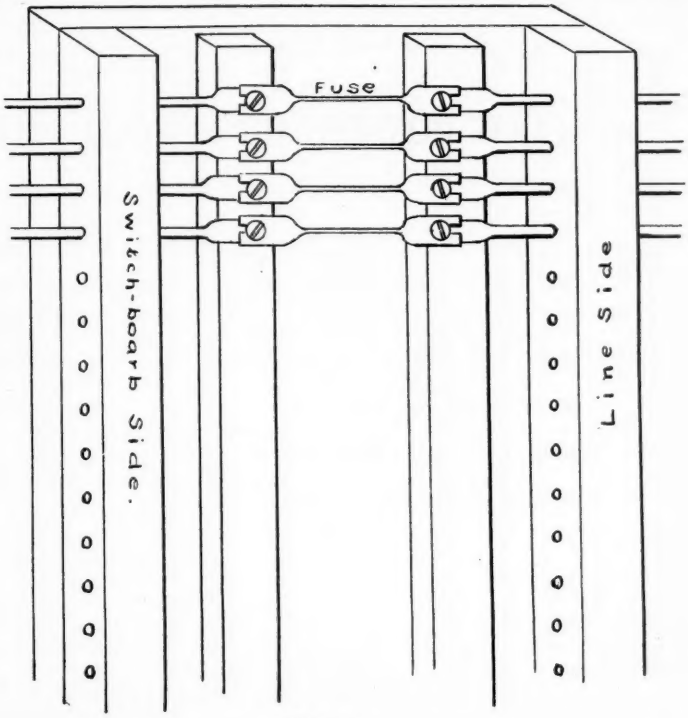


FIG. 2.

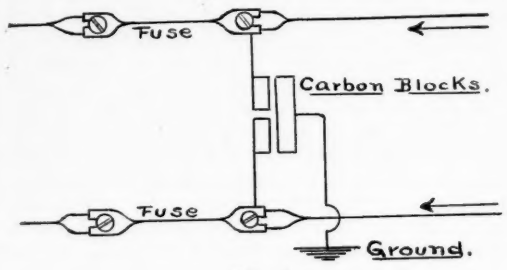


FIG. 3.

We will assume that the first line constructed is that of Hyde Bros., whose chair factory we find located at the railroad. As Mr. Chas. C. Hyde, the head of the concern, will also require a telephone, provision is made for connecting an instrument at his house to this line, so that communication may be established between factory and fresidence without calling central, by ringing upon the line as provided for in the system of ringing suggested for this exchange.

In selecting a line wire the different advantages of both galvanized steel and bare copper wire are to be looked into as regards first cost, maintenance and expense of handling, and it will probably be advisable to procure No. 12 gauge best galvanized iron wire, such as is listed at seven cents per pound, subject to discount in mile bundles. It is estimated that one mile of this wire will weigh 164 pounds, and bundles are usually in ½ mile coils. Glass insulators of a size suitable for properly running this wire through trees are of the type shown in Fig. 1, the price being 3 cents each by the hundred.

SPLICE.

There are two ways of placing the two wires in the trees; first, by fastening separate insulators as far

apart as possible in the trees, or else more uniformly, by means of a duplex bracket, which consists of a short, stout stick, a foot in length, bearing an insulator like Fig. 1 at each end. Such a bracket has the disadvantage of damage to both wires should the bracket split and fall away from the tree. In running the line to Hyde Bros., separate insulators are used, fastening same to either side of the main trunk of the trees where possible, in preference to swinging on less substantial branches.

The experienced lineman sent by the supply house will direct all the details of erecting this first line, to the point of entrance at the factory and the residence of Mr. Hyde, at which places the subscribers may feel confident of their ability to commence the work of installing the interior wires and instruments.

A 9-FOOT ROWING OR 12-FOOT POWER TENDER.

CARL H. CLARK.

I. Lines and Moulds—Tables of Offsets.

The two boats described in the present series of articles are designed to be of the canvas covered variety. This method of construction is very simple and easily carried out, thus being well adapted to amateur builders; at the same time it makes a very light boat and one which will not shrink and leak upon being out of water for some time. The small, 9 ft. boat is designed especially for rowing, as for use as a yacht tender, and being light is especially adapted for lifting on board when desired. She will carry three persons very comfortably, and four without trouble. The 12 ft. boat is fitted either for a power tender, using a 1½ h. p. motor, and will be described as such, although with the addition of a centerboard and sail plate she makes a comfortable and able sailing tender. For rowing alone she is rather wide and bulky.

The lines of both boats are shown in Fig. 1, those of both being practically the same except for size. These lines are the same as would be furnished to a boat builder, consisting of sheer plan top view, and end view showing shape of moulds or timbers. As will be noted, the frames or mould lines, 1, 2, 3, etc., which appear as straight lines on profile and top view, are curved in the end view or body plan. The water lines which are straight in body plan and profile are curved in the deck plan. The water lines are spaced 3 in. apart in the 9 ft. boat, and 4 in. in the 13 ft. The first step will be to lay off the lines and get them ready for use, the proceedure being the same on both boats.

TABLE NO. 1. OFF-SETS FOR 12-FOOT POWER TENDER.

Numbers of Moulds.	Stem	1	2	3	4	5	S
Height of gunwale	2′ 8 7-8″	2′ 5″	2′ 2 3-4″	2′ 1 1-4″	2′ 1″	2′ 1 5-8″	2′ 4 1-4″
Half breadth ,,		1′ 7 1-2″	2′ 3″	2′ 5 1-2″	2′ 4 3-4″	2′ 1″	1′ 8 1-4″
Half breadth w. l. 5		1′ 5 1-2″	2′ 2 3-8″	2′ 5 1-4″	2′ 4 3-4″	2′ 1 1-4″	1′ 8 1-2″
Half breadth w. l. 4		1′ 4 1-8″	2′ 1 5-8″	2′ 4 7-8″	2′ 4 1-4″	2′ 0 1-2″	1′ 5 1-2″
Half breadth w. l. 3		1′ 2 1-4″	1′ 11 7-8″	2′ 3 3-4″	2′ 3 1-8″	1′ 10″	5 1-4″
Half breadth w. l. 2		11 5 8″	1′ 8 3-4″	2′ 1 1-4″	2′ 0 1-2″	1′ 3 5-8″	
Half breadth w. l. 1		7 3-8″	1′ 3″	1′ 6 1-2″	1′ 4″		

Water lines are spaced 4″ apaat.

TABLE NO. 2. OFFSETS FOR 9-FOOT TENDER.

Number of Moulds.	Stem	1	2	3	4	5	S
Height of gunwale	2′ 0 3-4″	1′ 9 3-4″	1′ 8″	1′ 7″	1′ 6 3-4″	1′ 7 1-4″	1′ 9 1-8″
Half breadth ,,		1′ 2 5-8″	1′ 8 1-4″	1′ 10″	1′ 9 1-2″	1′ 6 7-8″	1′ 3 1-8″
Half breadth w. l. 5		1′ 1 1-4″	1′ 7 3-4″	1′ 10″	1′ 9 1-2″	1′ 6 7-8″	1′ 3 1-4″
Half breadth w. l. 4		1′ 0 1-8″	1′ 7 1-8″	1′ 9 5-8″	1′ 9 1-4″	1′ 6 1-4″	1′ 1 1-4″
Half breadth w. l. 3.		10 3-4″	1′ 5 3-4″	1′ 8 3-4″	1′ 8 3-8″	1′ 4 1-2″	3 7-8″
Half breadth w. l. 2		8 5-8″	1′ 3 1-2″	1′ 6 3-4″	1′ 6 3-8″	11 5-8″	
Half breadth w. l. 1		5 1-2″	10 1-4″	1′ 2 3-4″	1′ 0		

Water lines are spaced 3″ apart.

A full size reproduction of the profile or sheer plan must first be made on brown paper for reference. A base line is drawn as shown, passing through the top of the keel. The following description of the work for the small boat will apply equally to the large one by the substitution of the proper figures. The length, 9 ft., is laid off along the base line and a vertical line drawn at each end. From table 4 it will be seen that the distance of No. 1 mould from the stem is 1 ft 9 in., which is to be laid off from one end vertical. The spacings of the other moulds, 1 ft. 6 in., are laid off in turn; this should leave 1 ft. 3 in. from No. 5 mould to the stern, as in the last line of ta-

ble 4. Verticals are drawn at these points, care being taken to have them exactly at right angles with the base line.

The water lines Nos. 1, 2, 3, 4, 5, are now drawn 3 in. apart on the 9 ft. boat, and 4 in. apart on the 12 ft. The outline of the stem is gotten from table 3 by measuring forward from No. 1 mould on each waterline the distance given; thus, on waterline 5, 1 ft. 9 in. is laid off toward the bow, on waterline 4, 1 ft. 8½ in.; on No. 3, 1 ft. 7½ in., and so on, giving the outline of the stem as in Fig. 1, on the inner line. As will be noted, this curve runs into the vertical already drawn and extends up to the height of the gunwale. For striking in this

TABLE NO. 3. OUTLINE OF STEM.

Distance from No. 1 mould to stem on each w. l.

	9-FOOT TENDER.	12-FOOT TENDER.
Gunwale	1′ 9″	2′ 4″
Water line 5	1′ 9″	2′ 4″
,, ,, 4	1′ 8 1-2″	2′ 3 1-2″
,, ,, 3	1′ 7 1-2″	2′ 2 1-8″
,, ,, 2	1′ 5 7-8″	1′ 11 3-4″
,, ,, 1	1′ 2 1-4″	1′ 7″

and other curves a small batten of oak or other pliable wood is used about ¼ in. thick and ½ in. wide, held in place by brads or small awls stuck down either side of it. The sheer or gunwale line should now be struck in from measurements given in the offset table thus: From table 2 the height of gunwale on stem is 2 ft., 0¾ in., which is measured up on the stem above the base line, the distance 1 ft. 8 in. is laid up on No. 2; 1 ft. 7 in. on No. 3, and so on. For striking in this curve a stiffer batten should be used, about 1 x 1½ in. of pine or spruce held in place as before.

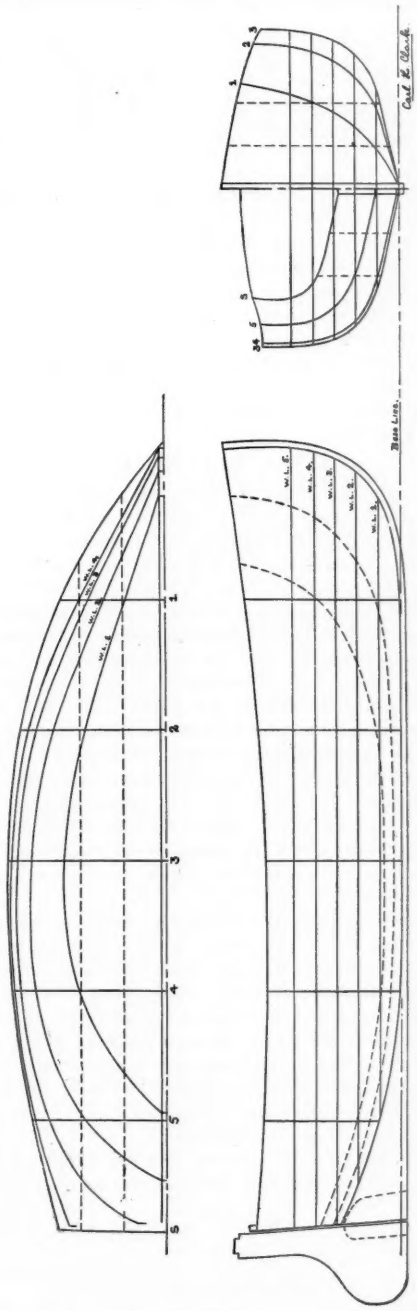
TABLE NO. 4. SPACING OF MOULDS.

	9-FOOT TENDER.	12-FOOT TENDER.
Stem farward of No. 1 mould	1′ 9″	2′ 4″
Spacing of moulds 2, 3, 4 and 5	1′ 6″	2′
Stern aft No. 5 mould	1′ 3″	1′ 8″

The after side of the stern is not vertical but rakes aft slightly,—1¾ in. and 2¼ in. respectively in the two boats; this distance being measured on the base line of the after side of the stern post drawn from this point to the intersection of the vertical and the gunwale.

The line of the upper curve of the deadwood is next located; it extends only on Nos. 4, 5 and S and is obtained by measuring up from the base line the proper distance on these sections; thus from table 5; ¼ in. is to be measured up on mould No. 4.; 3⅛ in. on mould Mo. 5, and 8¼ on the stern. This curve is drawn in, making a fair, smooth joint with the base line as shown. The profile should now appear like that in Fig. 1, with the exception of the dotted section lines and the keel.

The shapes of the cross-section or moulds are next to be laid off using table No. 2. Although in the drawing



the shapes of the several moulds are shown together for convenience, for use they should each be drawn on a separate sheet of brown paper. It will be necessary to lay off only on one side of each mould. A center

line and base line are drawn and the five waterlines 3 in. apart and parallel with the base line. Now, taking mould No. 3 as a sample, at the height of gunwale, 1 ft. 7 in., a line should be drawn parallel to the base line; having now the base line, five waterlines and the gunwale height line, the several half breadths from the table are to be laid off. The half breadth of gunwale, 1 ft. 10 in., is laid off from the center line on the line through the gunwale height; the half breadth on water line 5, 1 ft. 10 in., is laid out from the center line on water line 5; on waterline No. 4, 1 ft. 9⅝ in., is measured out; on waterline 3, 1 ft. 8½ in., and so on down to the base line, where the half breadth is ¾ in., or half the width of the keel. The other moulds are laid out in the same manner. It will be noted, however, that moulds No. 3, 4 and S do not extend down to the base but stop above it at the height given by table 5, the half breadths at this point being the same as that of the keel, ¾ in.

TABLE NO. 5. DEADWOOD.
Heights above base line.

	9-FOOT TENDER.	12-FOOT TENDER.
Height on mould No. 4	0 1-4″	0 3-8″
" " " " 5	3 1-8″	4 1-4″
" " " " S	8 1-4″	11″

The patterns of the moulds having been drawn it is necessary to take off from the outline the thickness of the planking, the lines having been drawn to the outside of the plank. This thickness is ¼ in. in the small boat, and 5-16 full in the larger one. This simply means the drawing of a curve parallel with and inside of the outline already drawn, a distance equal to the plank thickness. It should be noted that Nos. 3, 4, 5 moulds are practically straight from the keel to the first waterline, which should be carefully followed in laying out to avoid any possibility of roundness or barrel shape on the bottom which would tend to make her cranky.

It will be necessary to make a set of wooden moulds or forms, of the exact shape of the paper patterns. Directions for making moulds have several times been printed in previous issues. They should be made of ⅝ in. stock and be accurate to shape and both sides alike. The moulds should be strongly put together, as there is likely to be a considerable strain upon them and any springing will alter the shape of the boat. Great care must be taken that the moulds are of the correct width across the top as given by table 2.

This completes the preliminary work and the directions for starting the actual construction will now follow.

CORRESPONDENCE.

No. 127. So. ORANGE, N. J., JAN. 31, '06.

In an article recently published in AMATEUR WORK on induction coils by Mr. Graves he says a coil should be wound in sections. Does he mean cross sections or length sections? Also, in winding, do you wind from the right side to the left and then from the left back again?

Can you also tell me what size coil I will need for a wireless outfit to send messages about two miles?

T. G. C., Jr.

By "sections" Mr. Graves means thin sections of pan-cake form, the number and thickness depending upon the size of the coil. These are wound to proper diameter between discs of cardboard which have been previously soaked in paraffine wax. The process will be fully described in an article now in preparation to be published at an early date. The windings and connections between sections must be such as will send the current around the core and primary in the same direction. As it is more convenient, as well as less liable to short circuits, to connect the inside and outside terminals of adjacent sections together; every other section should be wound in the same direction, the inside terminal of one should be connected to the outside terminal of the next, the sections and separating discs being liberally coated with paraffine.

No. 128. SAN FRANCISCO, CAL., FEB. 12, '06.

Will you kindly tell me how to avoid the spark at break between two sliding contacts without the use of a condenser?

I have two magnets each wound with 400 turns of No. 30 B. & S. gauge wire, connected in the usual form and use three dry cells for an electric clock making contact every minute, but the sparking oxidizes the contacts and makes trouble. The condenser, consisting of 100 4 x 6 sheets of foil, also limits the spark to a degree.

T. W. H.

The spark at the breaking of the contact points is caused by the "extra current" or induced discharge of the magnet windings. Some form of condenser must be used to prevent it. It may also be well to introduce about 30 ohms of fine insulated German silver magnet wire in series with the condenser. The added resistance will lessen the amperage of the condenser discharge and greatly reduce the tendency to spark. If this does not fully cure the trouble, we would suggest that you make a condenser of tin foil, separated by thin, strong paper and then roll in tubular form. Wrap fine twine about the package to hold it in shape, and immerse in paraffine wax.

Electrical traction on Swiss railroads is a new thing; but it seems only natural that Switzerland, so rich in "white coal," begins to utilize its wealth of water, and supersedes, by the power derived from it, the enormous quantity of coal imported from Germany, France, Belgium and England. This new trial of electrical power on such an important new line will be watched with keen interest. If successful, the new mode of traction will certainly be employed all over the country.